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THE BONE CHANGES IN PRIMARY HYPOGONADISM[1]

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THIS report is based on observations made on nine cases of primary prepuberal hypogonadism. By this term we refer to that condition in which puberty has not taken place (absence of secondary sex characteristics), in which there is every evidence clinically of normal pituitary function, and in which there is no evidence of other endocrine disorders.

When the usual and normal physiologic changes caused by a particular gland fail to appear, it is, therefore, natural to assume that the gland is deficient. It must not be forgotten, however, that such changes are produced not only by the activity of the hormone in question but also by the ability of the end organ to react to that hormone. Furthermore, if there is evidence of activity of a certain gland, as determined by biological tests which even now are relatively crude, the product of that gland may fail to produce a reaction in the end organ because the hormone may be present in an inactive form.

A clear conception of these principles should simplify diagnosis of endocrine disorders. It is our belief that most endocrine disorders are primarily uniglandular in origin, and that many of the so-called pluriglandular syndromes will eventually be regarded as originating in one endocrine gland.

Deficient sex secretion causes different clinical pictures, depending on the time of life at which it occurs. Excluding pituitary disease, hypogonadism may be classified in relation to time of life, as follows: (1) Loss or failure of sex hormone to be secreted in infancy or childhood up to the usual time of puberty. This failure is followed by typical prepuberal or primary hypogonadism. (2) Loss or failure of gonadal secretion to act shortly after puberty. This may result in partial development of secondary sex characteristics and epiphyseal closure, although they may be delayed (Case 5). (3) Loss of gonadal secretions after epiphyseal closure. In this case there may be slight regression of sex characteristics or they may remain unchanged (Case 6, Fig. 1). The gain in weight so often ascribed to the termination of sex secretion, especially at the menopause, may be due to the loss of the special effect of sex hormone which produces that dynamic or energizing difference between a sexed and an unsexed person.

Apparently the true sex hormones of the gonads bring about epiphyseal closure, at least this phenomenon is closely associated with sex maturity. Longitudinal growth at the usual time of puberty cannot be attributed to sex hormones since it continues when these hormones are absent. Thus, open epiphyses are present in true primary hypogonadism and growth continues. This combination is practically pathognomonic

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of primary hypogonadism, providing growth does not proceed at an abnormal rate. Growth of long bones continues, resulting in time in disproportionate measurements, the span equalling and occasionally markedly exceeding the height. In the true hypogonad giant, growth does not proceed at an abnormal rate but only for an abnormal time. This is to be noted in contrast to the true pituitary giant. In one of our cases of pituitary gigantism the epiphyses remained open (Fig. 2). Puberty did not occur and growth continued at an abnormal rate due to an acidophilic pituitary adenoma. In this case had sex hormones been present, epiphyseal closure should have taken place, further longitudinal growth would have ceased, and acromegaly followed if the pituitary adenoma had remained over-active. Since such cases are almost always due to tumor, it is presumed that the sex-secreting cells, basophilic, are crowded out by the growth of the acidophilic tumor, thus preventing epiphyseal closure.

In a roentgenologic study of the bone in these cases of primary hypogonadism we have noted in addition to the recognized delayed epiphyseal closure an unusual bony structure. The changes found which we consider to be characteristic of primary prepuberal hypogonadism may be listed as follows in the order of their importance: (1) A tendency to longer bone growth; (2) delayed epiphyseal closure; (3) subcalcification; (4) thinning of cortical layer; (5) thin-walled, normal-sized trabeculation, and (6) roughening of metaphyseal margin of growing bone. It is likely that these changes may not be present in later decades of life as there is evidence in most cases of some gonad secretion, which, over a long period of time, brings about closure of epiphyses. Case 4 represents probably the greatest degree of gonad deficiency, almost approaching a true absence of sex

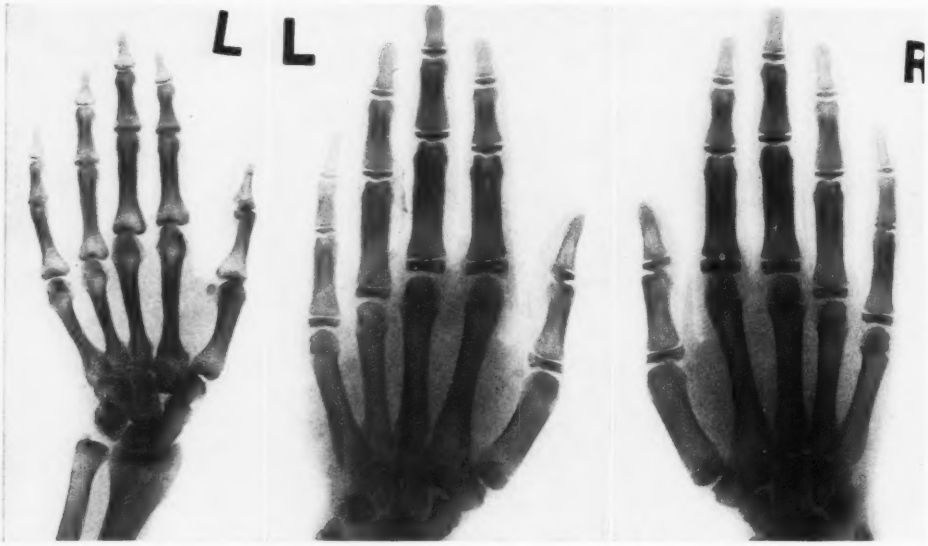

Fig. 1. Fig. 2.

Fig. 1. Case 6. Essentially normal hand in case of premature menopause.
Fig. 2. Secondary hypogonadism occurring in case of gigantism due to pituitary tumor in a male, aged 16 years. Note practically same bony changes except for tufting of distal phalanges. Bones also are proportionally over-size (length as well as width).

secretion, or agonadism. Dental caries has been noted in our cases, an observation mentioned by Englebach.

In this report we have included seven cases of typical primary prepuberal hypogonadism, four males and three females. We have also, by way of comparison, added two cases of postpuberal hypogonadism in young women.

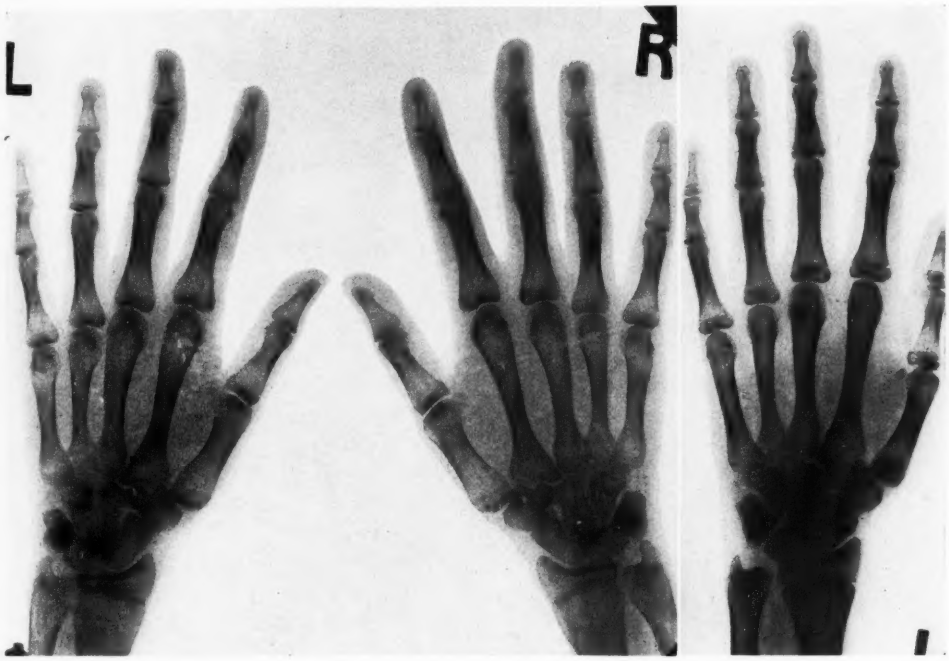

Fig. 3-*A*. Fig. 3-*B*.

Figs. 3-*A* and 3-*B*. Cases 1, 2, and 3. Primary prepuberal hypogonadism in females aged 18, 29, and 55 years, respectively. (See Figure 3-*C*.) Typical bone changes are shown. Note subcalcification, open epiphyses, thin cortical layer and thin-walled normal sized trabeculations, and length of metacarpals and phalanges.

Case 1 is typical of primary hypogonadism in a woman 29 years of age (see résumé of individual cases). Roentgenograms of the hands of this patient are shown in Figure 3. The long, tapering hand is well demonstrated, along with open epiphyses. We desire to call attention especially to the subcalcification, thinning of the cortex of the phalanges, thin-walled, normal-sized trabeculation, and roughening of the metaphyseal margins. These changes, we believe, are characteristic of hypogonadism.

Case 6 was selected to show the lack of change in a woman of the same age, with a postpuberal hypogonadism. Actually, this is an unusually premature menopause. No abnormality is to be seen unless the epiphyseal line, usually not visible, is to be considered evidence of retarded closure. This patient menstruated between the ages of 12 and 14 years, during which time sufficient sex hormone was available to produce mature secondary sex development and normal bone growth. Urine assay showed positive prolan and negative estrogenic reaction in mice, typical of menopause.

Case 2 (Fig. 3), a girl 20 years of age, shows all the characteristic findings of hypogonadism. This patient had never menstruated and clinically was a typi-

cal prepuberal case. Curiously, three assays of urine and one of the blood for prolan gave negative results, and two assays of urine and one of the blood for estrogenic factors gave 1 to 2+ reaction, which would suggest ovarian activity. This finding of estrogenic substances emphasizes the importance of bearing in mind what has previously been stated, namely, that it matters little how much hormone may be present in the body if the organ on which it acts is incapable of reacting or if the hormone is imperfect and incapable of stimulating the end organ. This would appear to be true here. It is also possible that there may be ovarian secretion in an inactive form resulting in clinical hypogonadism in the presence of active ovaries.

Case 3 (Fig. 3) illustrates another typical case in a woman 55 years of age. Even in well-marked hypogonad cases, epiphyseal closure will take place in time, usually after thirty, and this was true of this woman. However, inspection of the scapula showed open epiphyses. In this case, too, there was marked decalcification, resulting in compression of the dorsal vertebræ of the spinal column. The other characteristic changes may be seen in the phalanges.

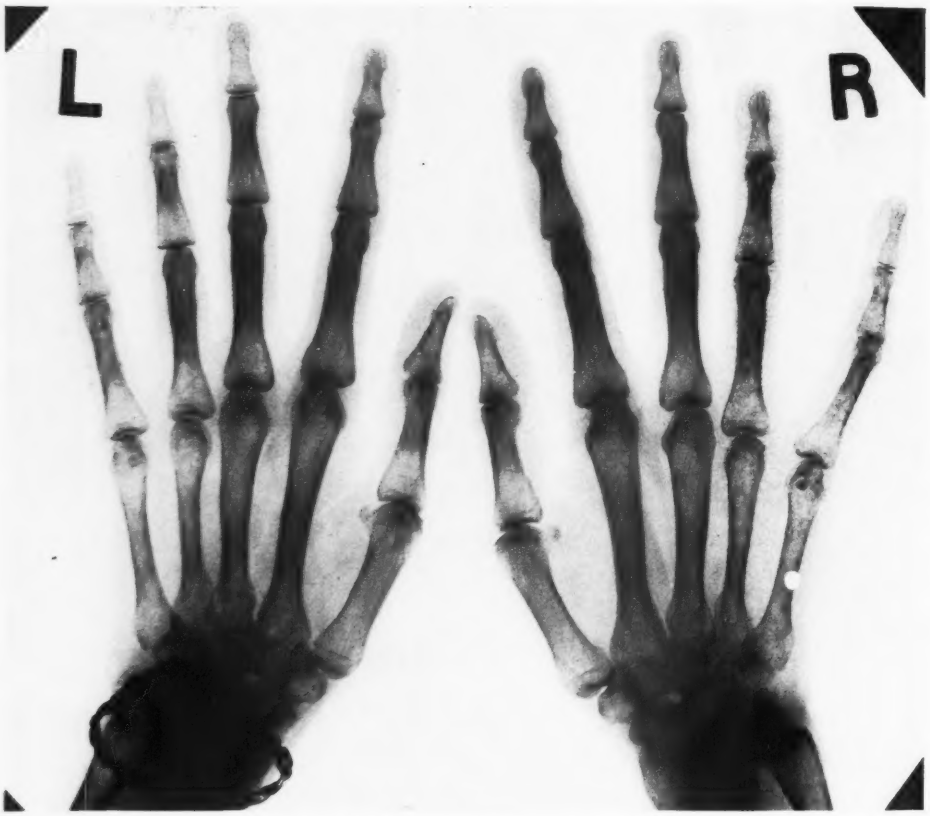

Fig. 3-C. See caption under previous cut.

Case 7 (Fig. 4) illustrates the same changes in a male aged 20 years.

Case 8, a man of 60, showed no characteristic bone changes in spite of being clinically a case of hypogonadism. In this case there may have been sufficient sex hormone to have gradually brought about

epiphyseal closure although clinically he showed no secondary sex characteristics.

We have under observation at the present time a boy, ten years of age, whose testes are undescended. Exploration some years ago revealed no trace of testicular tissue. Clinically, he is as yet not physically hypogonad, and roentgenologic changes are not apparent. It is doubtful if they can be illustrated or expected until a year or more after puberty should have taken place.

DISCUSSION

We believe typical and well-marked primary prepuberal hypogonadism may show characteristic bony changes aside from the recognized delayed epiphyseal closure and elongated bone. These changes may be differentiated from other endocrine bone changes such as those seen in pituitary acromegaly and gigantism, prepuberal myxedema, and prepuberal pituitary dwarfism or infantilism.

REPORT OF CASES

Case 1. A female, aged 29 years; weight, 140 pounds; height, $69^1/_2$ inches; span, $68^1/_2$ inches; pubis to floor, 36 inches. The breasts were flat, and pubic and axillary hair very scanty. She had long legs and arms. She had never menstruated and said that for the past four or five years she had grown two or more inches. Prolan in the urine was in excess; examination for estrin gave negative results.

Roentgenologic examination revealed that the skull was normal. The sinuses were moderately well developed. There was marked dental caries. The long bones were increased in length and all epiphyses were still open except in the feet. There was subcalcification, thin-walled, normal-sized trabeculation, and roughened metaphyseal margins. Apophyses of the vertebræ and pelvic bones remained open.

Case 2. A female, age 20 years; weight, 103 pounds; height, $68^1/_4$ inches; span, $70^1/_4$ inches; pubis to floor, 36 inches. Eighteen months later the height was 69 inches; span, $70^1/_2$ inches, and weight, 154 pounds. She had never menstruated. The breasts were undeveloped and the amount of pubic and axillary hair was subnormal. The uterus was found, on rectal examination to be very small. The upper teeth were out because of early decay. Examination of the urine revealed estrogenic factors, 2+ on one occasion and 1+ on two other occasions. The blood estrin was 2+ on one occasion. Tests three times a week for prolan in the urine were negative, and examination of the blood for prolan was positive on one occasion.

Fig. 4. Case 7. Primary prepuberal hypogonadism in a male aged 21 years. Note same changes as in females.

Roentgenologic examination revealed that the sinuses were well developed. A slight spongy appearance of the cranial vault was observed. The epiphyses in the hands were open. All the long bones, the pelvis, and knees showed poor calcium content but normal, thin-walled trabeculations. The knee and femoral epiphyses

were open and there was no apophyseal development of the crest of the ilium.

Case 3. A female, aged 55 years; weight, 125 pounds; height, $67^1/_4$ inches; span, 78 inches; pubis to floor, 38 inches. The breasts were under-developed, and pubic hair was very scanty. Kyphoscoliosis was observed. The pelvic organs were not felt by rectal examination. She had never menstruated, and complained of weakness and easy fatigability. She was placed on a low, measured calcium diet, and urinary excretion was determined. There was no excess calcium excretion. Blood calcium was 9.8 mg. per 100 c.c.; blood phosphorus, 4.4, and phosphatase, 2.11 Bodansky units. The basal metabolic rate was −3. Examination of the urine for prolan gave negative results.

On roentgenologic examination the sinuses were found to be well developed. The skull was normal. Many of the lower teeth were out. Bones of the hands and feet were long. Epiphyses of the long bones were closed, but epiphyseal line remained. There were nutritional bands in the tibia. The cortex of the bone was thin, the trabeculations sharp and well defined. The calcium content was markedly decreased, resulting in compression of the vertebræ of the dorsal spine. Apophysis of the scapula remained open. No hypertrophic changes were seen.

Case 4. This patient was an unmarried girl of 19 years, showing characteristic changes of primary hypogonadism. She weighed 137 pounds, her height was $67^7/_8$ inches; span, 69 inches. Axillary hair was scanty. She had a moderate amount of pubic hair. The uterus was not felt; the cervix was infantile. The teeth were in good condition. Roentgenograms showed long fingers, open epiphyses, subcalcification, thinning of the cortex, and the other changes found in cases of hypogonadism.

Case 5. A female, aged 18 years, had scanty pubic hair and under-developed breasts, and was thin. No measurements were taken, but she was not disproportionate. She had menstruated for two years and then stopped. She had a colloid goiter. Prolan in the urine was graded 2+; examination for estrin gave negative results. Roentgenologic examination revealed that the skull was normal. The epiphyses were closed and there were no bony changes. This is a case of postpuberal hypogonadism or premature menopause.

Case 6. A woman, aged 29 years, had developed normally with well-marked secondary sex characteristics. Her height was $58^1/_4$ inches: weight, $170^3/_4$ pounds. She menstruated from the ages of 12 to 14 years, but never since then. The uterus could not be felt by rectal examination. Libido was excessive. Examination of the urine for prolan gave positive results and for estrin, negative results. Roentgenograms showed the epiphyses closed but the epiphyseal line remained visible. There were no other changes. This is a case of postpuberal hypogonadism or premature menopause.

Case 7. A man, aged 21 years, was a typical case of hypogonadism. The voice was high-pitched: he had no beard: female skin and contour. The penis and testes were very small and there was a small amount of fine pubic hair. Libido was absent. The patient was introverted and depressed. Measurements were not taken at this time, but the lower extremities were long, the hands and fingers were long and tapering. The bones showed subcalcification, trabeculations were finer than normal; the cortex was thin, and metaphyseal margins of growing bone were roughened. In November, 1938, the patient was $73^1/_2$ inches tall and weighed 196 pounds: his span was 76 inches.

Case 8. A man, aged 60 years, weighed 147 pounds: height was $70^1/_4$ inches. The voice was high-pitched, the skin lined and wrinkled, and he had female contours. The penis was very small, and the testes were the size of beans. The prostate gland was barely palpable. This patient was seen only once and further studies were not possible. Roentgenologic examination showed no hypertrophic changes and no changes characteristic of hypogonadism.

Case 9. A man, aged 30 years, illus-

trated typical hypogonadism. He weighed 201 pounds; height was 70 inches; span, $69^{3}/_{16}$ inches; pubis to floor, $37^{1}/_{2}$ inches. The penis was very small, and the testes were the size of peanuts. Pubic hair was scanty. He had been sickly until he was five years of age. He had had an occasional erection, but never seminal emission. He was not overweight until he was 20 years old, when he began to eat large amounts of sweets.

Roentgenologic examination revealed the following: the cranial vault was of average thickness without localized changes: the sella was normal: the sinuses were exceptionally well developed: the teeth showed advanced dental caries: the long bones apparently were not elongated: epiphyses were open in the ulna, radius, femur, tibia, humerus, and fibula: metacarpal epiphyses were closed. No apparent decalcification was observed, although the cortex was thin. Trabeculations were normal.

Case 10. A man, aged 24 years, weighed 172 pounds; height, $72^{1}/_{8}$ inches; span, $78^{5}/_{8}$ inches; pubis to floor, $39^{1}/_{4}$ inches. The skin was fine and slightly wrinkled around the eyes. Dental caries was present. The voice was high-pitched. His hair was graying. No beard or secondary sex characteristics were observed. The penis and testes were small. The patient married while he was under observation and claimed libido was normal and that he had erections. He received injections of male sex hormone three times a week for about four months and thought there was increase of hair on the mons pubis, but this was doubtful. Roentgenologic examination revealed that the sinuses were well developed. The skull did not reveal any abnormality.

Case 11. A man, aged 21 years, was tall and had feminine contours. He weighed 167 pounds: height was 72 inches. The beard was absent, the voice adolescent, penis small, and testes undescended. He had flat feet. The skull and sella turcica appeared to be normal on roentgenologic examination. Roentgenograms of the wrist showed that the ulna and radial epiphyses were open. The bones appeared decalcified, with thin cortex and fine, thin-walled trabeculations.

DISCUSSION

CARLETON B. PEIRCE, M.D. (Royal Victoria Hospital, Montreal, P.Q., Canada): I am very much honored to be asked to open the discussion on Dr. Hare and Dr. Hurxthal's paper, and, as a mere radiologist, to consider the biochemical and endocrine problems of the syndrome which Dr. Hare has presented.

As radiologists, we are all familiar with the problem of determination of some correlation between the physiologic or skeletal age of individuals and their chronologic age. Extensive studies have attempted to establish for us normal base-lines for various growth periods.

Dr. Hurxthal and Dr. Hare are now calling our attention to a syndrome well beyond the margins of the normal, and have led us into the field of the hormonal control of growth about which our colleagues, the biochemists and endocrinologists, have dug out much information in the past few years. However, theory still remains as the basis of much of our current concept of the inter-relation of the ductless glands, their products, and their effect on the life of the individual.

As regards the sexual and skeletal development, so far as our present state of knowledge goes, the pituitary must be regarded as the central control, or so it seems to me and to my colleagues with whom I have discussed the matter since receiving Dr. Hare's paper. By some means it acts as a control catalyst for the hormonal products of the gonads, thyroid, and adrenals, especially.

So far as I can find out, there have been no known hypophysectomized animals in which epiphyseal closure could be induced by administration of estrin. As a corollary, Gardner and Pfeiffer, working in Allen's laboratory, have recently reported on a series of mice, not hypophysectomized but given very large doses of estradial benzoate weekly up to a period of 348 days. These animals showed an endosteal bone

formation nearly or completely replacing the marrow of the femur and the other bones (except the pubis at the symphysis, which is known to undergo bone resorption in the presence of administration of large amounts of estrin).

These animals further presented an early closure of certain epiphyseal growth zones which are commonly late or incomplete in closure in mice. Those of you who have worked with these experimental animals, I think, are aware of the fact that many of the epiphyses in mice and rats close quite late in the period of growth or may never close. These men also obtained a similar effect with testostrone.

Furthermore, the hypophysectomized animals, so far as we know, will not develop a normal uterus or mammæ upon the administration of doses of sex hormones. I have asked Dr. Hare this morning how we could be sure that the pituitary was quite normal in his patients. Of course, in this whole problem, one still has to depend upon really very indefinite clinical means of measurement and a certain amount of biological assay.

As to the presence or absence of demonstrable gonadal tissue, it has been established pretty thoroughly that both androgens and estrogens may be elaborated by extra-gonadal tissues—the adrenals, for instance.

In regard to the possibility that the sexual hormonal elements are present in an unused or unstable state in the circulation such is still possible—and a theory which Dr. Hare has offered for consideration. It is quite probable that these glucuronides may be synthesized by the gonadal tissues or may be conjugated elsewhere, such as in the liver, but that the enzyme which may be necessary for their activation at the epiphyseal growth zones, in the skin or the developing secondary appendages of the skin, etc., may be absent at the time or point desired, so that the development does not pursue its normal course.

Again, we cannot be sure that this may not be due to a deficiency in the catalyst of the somatotropic factor from the pituitary. So far, there is very little factual knowledge in regard to this latter.

The thought occurred to me while studying Dr. Hare's paper that possibly this may again be linked up with the "x" factor which we have been considering in the development of carcinoma. The question recurs as to why certain individuals who are subjected to irritation, to trauma, or to other "causative" factors, do not develop carcinoma, while others do. If we can look upon carcinoma as the result of a lack of a control factor in the tissue itself, it may be that all this is tied in together.

I have already asked Dr. Hare this morning, and I would like to ask him again, to tell us how frequently, and at what periods, the assays in regard to the prolan and estrin were carried out. The reason I ask is that there is a feeling among endocrinologists and biochemists that the discharge of prolan or estrin is largely a discard, an indication of unused material, and is not an indication of the total which is actually available for the individual.

In regard to the thinness of the cortex, I have been very much interested recently in following the work of Mortimer in which he has demonstrated rather thoroughly—at least to my satisfaction—that in the hypophysectomized individual (the experimental animal) there is a very definite thinning of the cortex, with a thin calvarium and a relative non-development of the frontal sinuses. That seems to be sufficiently positive to permit us at the present time, on examining human individuals, to regard such changes as indicative of some pituitary disorder.

I appreciate very much this privilege, and I feel that Dr. Hare and Dr. Hurxthal have presented to us a group which certainly we should study and investigate further. Perhaps this syndrome may explain some of the discrepancies between the chronologic age and the physiologic or skeletal age as we have been trying to establish them.

DR. HARE (*closing*): I wish to thank Dr. Peirce for being so considerate in his discussion. I realize that there may be room for some doubt as to whether this disorder is primarily of gonad or pituitary origin. While we feel that it is primarily gonad, we realize it cannot be definitely stated at the present time. In determining whether to call this disorder hypogonadism it was necessary to review our files, studying roentgenograms of pituitary or other endocrine disturbances for comparison. In the days of the Turkish harem, at which time hypogonadism was frequent, these individuals showed physical changes such as were present in our cases. These were produced by surgical removal of the gonads.

As far as the biological tests are concerned, in some cases only one assay of the urine was made; in other cases four or five assays of blood and urine were done. The assays were done only in the female patients. The most frequent finding, of course, was the presence of prolan and the absence of estrin, but there were several patients in another group who displayed more than the usual amount of estrin found in normal women and no prolan. In both cases the clinical evidences of hypogonadism were definitely present. It seems to us that if the disorder were primarily pituitary deficiency, neither of these substances would show up in the urine or blood.

In presenting this paper I hope that we may be able to recognize this disorder, because early treatment now is very promising, especially in the male.

I overlooked the first four cases which came through the clinic. The diagnosis was brought to my attention by Dr. Hurxthal, who is interested in this group, and since then in five cases I have been able to make the diagnosis from the roentgenograms alone. It is of help to the patients to know exactly what the situation is because many of them are discouraged and, when it is once explained to them, at least they have a clearer insight into the future.

PHYSICAL MEASUREMENTS ON ROENTGEN RADIATION FROM A TUBE ACTUATED BY A VAN DE GRAAF GENERATOR

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AS a source of potential for the production of supervoltage x-rays, a Van de Graaf generator has been in use at the Collis P. Huntington Memorial Hospital for some months, and the present paper is a report of some of the measurements made on the radiation secured from a roentgen tube actuated by this generator. A description of the machine itself has been given previously (4, 12) and need not be repeated in detail. The roentgen tube is in a vertical position with the water-cooled target at ground potential. Originally, the target was a lead-plated sheet of copper inclined at about 38° to the horizontal so that radiation could be examined in the vertical direction, that is, at an angle of 0° with the electron beam, or in the horizontal direction at an angle of 90° with the electron beam. This arrangement was soon modified, however, by replacing the 38° lead target by a gold-plated horizontal target so that at present only the vertical radiation is available for experimental purposes.

The method of measuring the voltage, as has been described previously (12), consists in measuring the current through a high resistance in parallel with the tube. This resistance had been calibrated at low voltages and also at higher voltages with spark gap and generating voltmeter. For short runs this was quite satisfactory, but with prolonged running there was apparently an increase in voltage, though the x-ray output remained constant. This indicated a decrease in value of the high resistance in parallel with the tube. Therefore, a corona meter was installed as a check on the constancy of voltage and all voltage determinations were made with the high resistance before any prolonged running. As a further check on output, a parallel-plate ionization chamber was connected to the input of a direct current amplifier and the output read on a five micro-ampere meter. This apparatus was made by Mr. B. J. Cosman. The ionization chamber is placed permanently in the x-ray beam and serves merely as an indicator of constancy of x-ray output.

By carefully maintaining the corona meter current, x-ray tube current, and x-ray output meter reading constant, one can secure a very stable and satisfactory source of radiation. Of course, maintaining any two of these readings constant should be sufficient, but three serve as a better check. Maintaining the x-ray output meter constant is by no means sufficient, since a decrease in voltage may be compensated for by a higher current. Consequently, during physical measurements the voltage was determined at the very beginning of the run by means of the current through the high resistance and then kept as nearly constant as possible by reading the corona current, tube current, and x-ray output. The voltage measurements are considered accurate to ± 2 per cent.

The first measurements were made on the radiation in the horizontal direction, that is, at an angle of 90° to the direction of the electron beam. For this purpose a large parallel-plate ionization chamber was constructed, in which the plates were one meter square, and their separation could be varied up to a maximum of 30 cm. A section of the lower plate, 5 × 15 cm., was insulated and served as the collector electrode. The longer dimension of this plate was perpendicular to the direction of the radiation. Saturation voltage for 30 cm. separation was found to be 4,000 volts, and during measurements a potential difference of 12,000 volts was maintained between the two ionization chamber plates.

The target of the x-ray tube is surrounded by three inches of lead, and an opening one inch square allowed the rays to pass through this surrounding lead shield. Pin-hole photographs of the target indicated a focal spot of about two and one-half centimeters in diameter. The x-ray beam was collimated by suitable openings in lead blocks 10 cm. thick, the first of which was placed against the lead shield of the tube and contained an opening 1.0 × 2.5 cm. Other collimating slits could be placed at various distances between source and collecting electrode—a distance of 180 cm.

The ionization current was read in the x-ray control room on a sensitive galvanometer connected between the collector electrode and the ground. A cylindrical lead shutter 8 cm. thick was mounted on a horizontal axis and a suitable slot cut along a radius from the periphery to about one-half the length of the radius. This slot could be moved to the horizontal position, allowing the radiation to pass, or placed vertically, thereby shutting off the radiation from the ionization chamber. This shutter was motor-driven and was controlled from the x-ray control room.

For measuring the penetration of the radiation in various materials, a filter carrier was arranged in such a way that a remote control switch allowed the insertion of various thicknesses of suitable materials in the x-ray beam. In order to avoid as far as possible scatter from the filter material itself, the filter carrier was placed as near as was feasible to the source of x-rays, and the x-ray beam was kept fairly small in cross-sectional area. In the horizontal direction, the beam which entered the ionization chamber was 3 × 6 cm., with the filter 150 cm. from the chamber. In the vertical direction, the beam at the ionization chamber was 8 × 10 cm. and the filter was 75 cm. distant from the chamber.

The purpose of the large ionization chamber was to study first the quality of the radiation, and then, at various voltages, compare the readings of the large chamber with those of a small air-wall thimble chamber. Only a small part of this program was carried out before a change in the form of target necessitated abandoning experimentation on the horizontal radiation.

For the radiation parallel to the electron beam, the large air chamber cannot be used, and so a small, thin-walled bakelite chamber was constructed and connected to the input of a direct current amplifier and the output of the amplifier was read on a short period galvanometer.

For intensity measurements in roentgens per minute, two Victoreen condenser r meters were used—one reading 25 r full scale and the other 100 r full scale. They agreed within an experimental error of ± 2 per cent. For absorption measurements, all the chambers agreed satisfactorily in that they gave consistent values of the absorption coefficient under like conditions of voltage and filtration. This might be expected since the determination of absorption coefficients involves the ratio of readings taken on the same instrument and over a limited wave length. However, for intensity measurements in roentgens per minute, neither the large air chamber nor the bakelite thimble chamber agreed with the r meters, but one would not expect agreement at high voltages since the bakelite chamber is constructed of thin "non-air wall" material. Other workers (5, 6, 8, 10) have shown that highly penetrating radiation readings, by means of open air chambers of the size used here, do not agree with those of thimble chambers. The question then arises as to how far one is justified in assuming that the readings of the r meters may be taken as correct. One of these instruments was checked previously (9) with radiation up to 400 kv. by comparison with an effect of radiation on chromosomes. The production of chromosome abnormalities in root tip cells due to radiation was the effect studied, and the percentage of normal anaphase chromosomes, three hours after irradiation, was the criterion for dosage determination. It was found previously that the readings of the r meter

agreed well with the dose as determined by the percentage of normal anaphases for the radiation from 120 to 400 kv. The same comparison was made at 1,000 kv. and again the readings of the Victoreen r meter agreed, within an experimental error of 5 per cent, with the dose as determined from the curve relating percentage of normal anaphases and dose in roentgens. These determinations were made in air, without back-scatter, and under these conditions it is believed the r meters may be used to read roentgens correctly for 1,000 kv. radiation within an experimental error of ± 5 per cent.[1]

The first target used for physical measurements consisted of lead plated on $^1/_{16}$-inch copper and this was cooled by water which flowed in a sheet $^1/_{16}$ inch thick between the copper backing of the target, and another $^1/_{16}$-inch copper plate. It is difficult to estimate just how much inherent filter is present in the path of the radiation in any direction since it is pos-

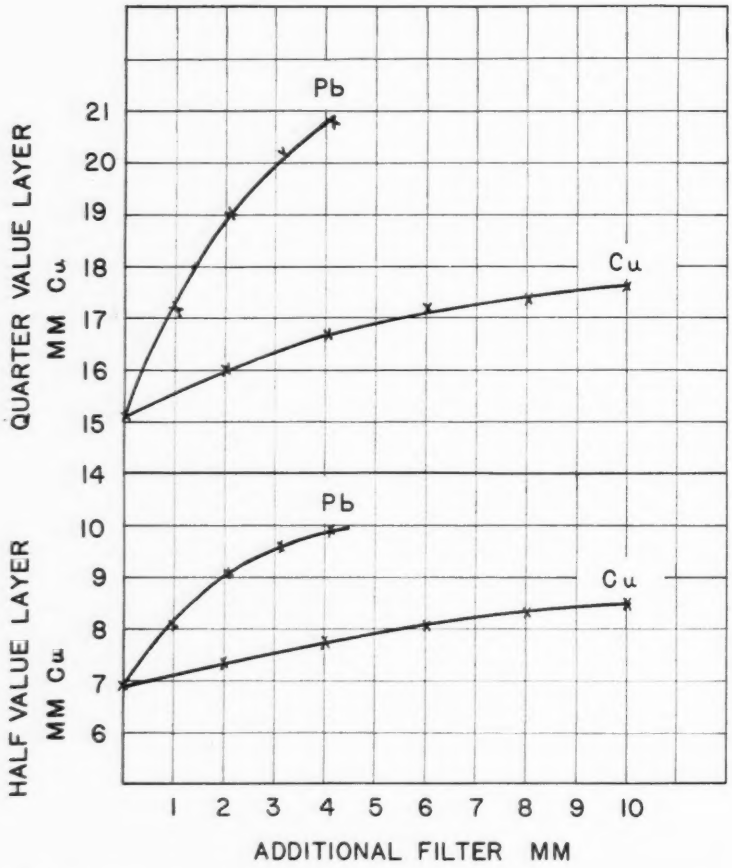

Fig. 1. Half and quarter value layers in millimeters of copper for various added filters of copper and lead; 1,000 kv. radiation normal to the direction of the electron beam. Initial filter, 5.2 mm. Cu.

[1] I am indebted to Dr. A. Marshak for assistance in making this check.

sible that some of the electrons pass right through the target and their energy is transformed into energy of radiation in the electron beam, were performed after the lead target had been replaced with a gold-plated target. In this case the gold

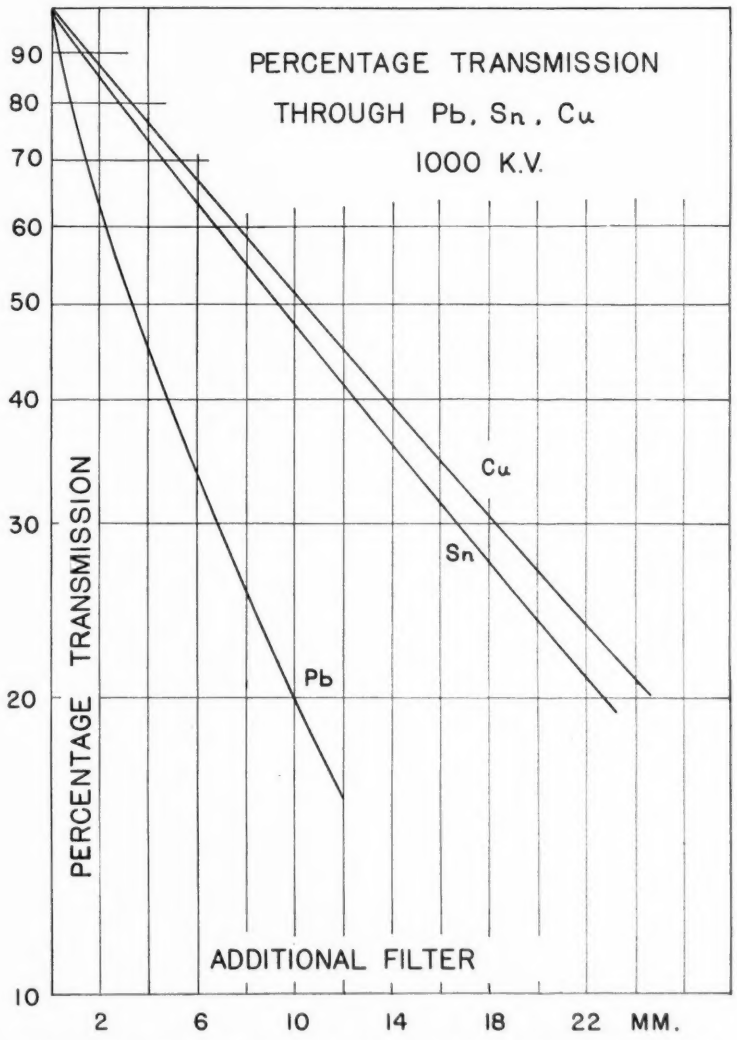

Fig. 2. Percentage transmission through lead, tin, and copper. Radiation parallel to the direction of the electron beam, 1,000 kv. Initial filter, 2.4 mm. Cu, 1 mm. Pb, 1 mm. Al, 2.6 mm. Cu, 1 mm. Al. Added filter placed between 1 mm. Pb and 1 mm. Al.

the water jacket or in the outside copper plate. However, the total thickness of copper in the horizontal direction is 5.2 mm. and this is taken as the inherent filter for the horizontal radiation. The experiments on the radiation, parallel to is plated on $^{3}/_{64}$-inch copper and another $^{3}/_{64}$-inch copper plate forms a water jacket $^{1}/_{16}$ inch thick. Again the thickness of the copper is considered the inherent filter, and in this case is 2.4 mm. Cu.

The vertical radiation is used for clini-

cal work and the conditions of treatment are: 1,000 kv., 70 cm. F.S.D., total filter 2.4 mm. Cu, 3.3 mm. Pb, 1 mm. Al, 2.6 mm. Cu, 1 mm. Al. Under these conditions the x-ray output is 47 r/min./ma.

The first measurements of the quality of the radiation were made with copper filters, and the half value layer in copper was determined with various thicknesses of lead and copper filters added to the inherent filter. The curves showing the results for the 90° radiation are shown in Figure 1. It is evident that copper is not a satisfactory filter for supervoltage radiation, nor is it suitable as a means of determining the quality of the radiation. The copper absorption coefficient changes slowly with wave length for highly pene-

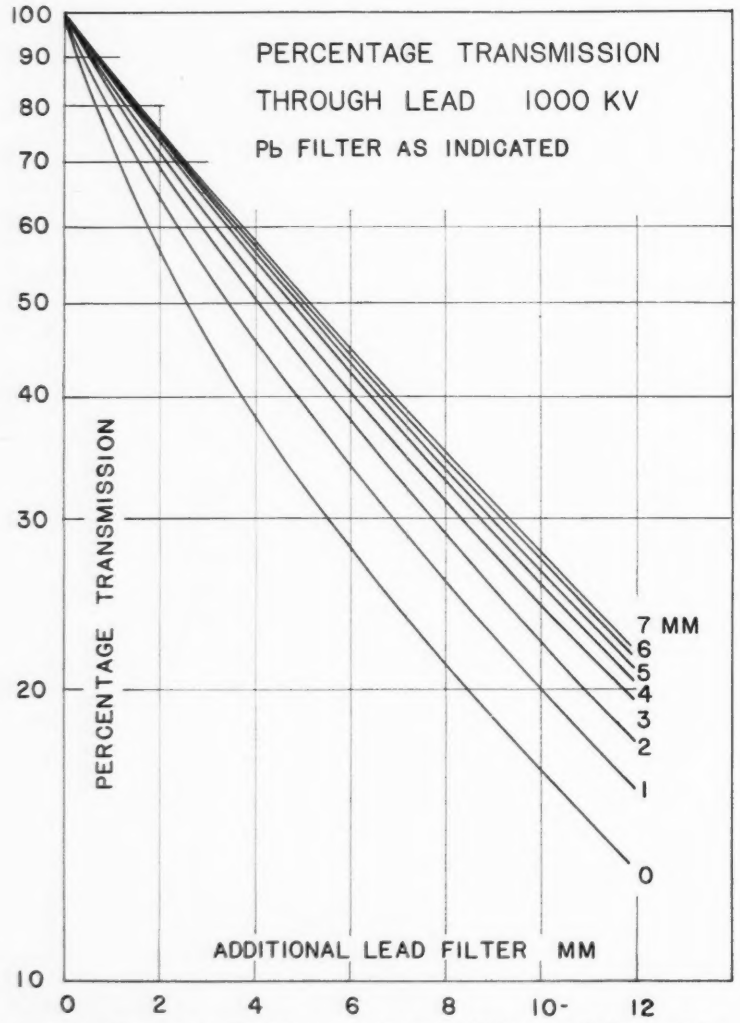

Fig. 3. Percentage transmission curves for lead, 1,000 kv. Radiation parallel to direction of electron beam. Initial filter, 2.4 mm. Cu, 1 mm. Al, 2.6 mm. Cu, 1 mm. Al. Additional lead placed between 2.4 mm. Cu and 1 mm. Al.

trating radiation, due to the fact that scattering is the predominant process of absorption at short wave lengths and relatively low atomic number absorbers. The so-called "true absorption," which varies approximately as the cube of the wave length, plays a minor part in the absorption of short wave lengths in copper but a larger part in the case of lead and other elements of high atomic number. Consequently, the quality of supervoltage radiation should be expressed in terms of its half value layer in lead or platinum.

Absorption curves of the vertical radiation for lead, tin, and copper are shown in Figure 2. This is for the radiation parallel to the direction of the electron beam and the conditions are as follows: 1,000 kv., 2.4 mm. Cu, inherent filter; added filter 1 mm. Pb, 1 mm. Al, 2.6 mm. Cu, and 1 mm. Al. Abscissæ represent millimeters of additional filter, while ordinates represent percentage transmission.

In Figure 3 the absorption curves for lead of the vertical radiation are shown, successive curves indicating the addition of one millimeter of lead. It is seen that so far as absorption in lead is a criterion of hardness, there is little advantage in adding more than 4 mm. of lead external filter for 1,000 kv. radiation. This is better seen in Figure 4, in which the half value layers in lead, tin, and copper are plotted as ordinates against added millimeters of lead external filter as abscissæ. The half value layer in copper for 1,000 kv. radiation, normal to the electron beam, is shown in the same figure. The total filtration for the horizontal radiation is somewhat greater than that for the vertical radiation and so the two beams are not strictly comparable. However, it is evident that the radiation parallel to the electron beam is more penetrating than that normal to the electron beam. For the former, with total filter of 2.4 mm. Cu, 2.6 mm. Cu, 2 mm. Al, the half value layer in copper is 10.2 mm., corresponding to an effective voltage of 475 kv., while for the latter, with 5.2 mm. Cu as total filter, the half value layer in copper is 6.9 mm., corresponding to an effective voltage of 290 kv. This gives a difference in effective voltage, as determined from half

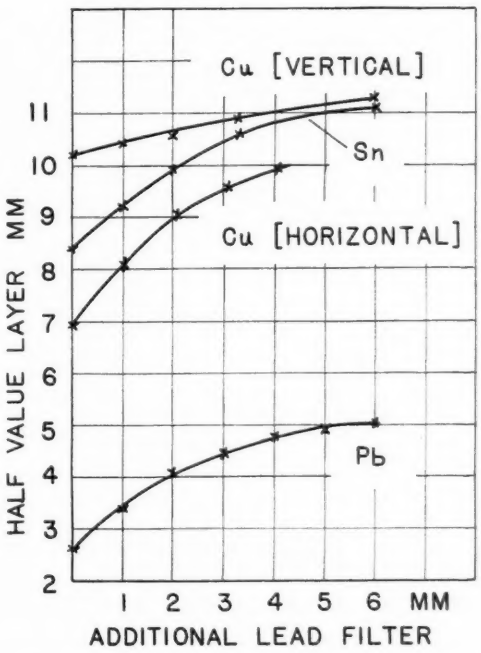

Fig. 4. Half value layers in lead, tin, and copper for 1,000 kv. radiation parallel to electron beam (vertical) and in copper for 1,000 kv. radiation normal to the electron beam (horizontal). Initial filters, vertical, 2.4 mm. Cu, 1 mm. Al, 2.6 mm. Cu, 1 mm. Al; horizontal, 5.2 mm. Cu.

value layer of copper, of 185 kv. in favor of the radiation parallel to the electron beam. This is in agreement with the results of Corrigan, Cassen, and Hayden (2). Data on relative intensities of the horizontal and vertical radiations would be interesting but such a comparison is not possible at present.

For clinical work, the filter is 2.4 mm. Cu, 3.3 mm. Pb, 1 mm. Al, 2.6 mm. Cu, 1 mm. Al, and the half value layers for this radiation are 4.6 mm. lead, 10.6 mm. tin, or 10.8 mm. copper. These correspond to mass absorption coefficients of 0.134, 0.089, and 0.072 for lead, tin, and copper, respectively. From the works of Read (12),

Jones (7), and Cuykendall (3), one can secure an approximate value of wave length corresponding to these absorption coefficients. From these experiments result the values 0.021 Å., 0.022 Å., 0.020 Å., with the value 0.021 Å. from the half value layer of lead being the average and probably the most accurate as well.

Absorption curves for tin, at various voltages and filters, are shown in Figure 5. For the higher voltages lead would have been a more suitable substance than tin but for the lower voltages copper would be more satisfactory. However, tin was used as most suitable to cover the entire range with one material. The radiations at 300 kv. and 400 kv. were observed at an angle of 90° to the electron beam from a commercial 400 kv. machine; all the other values were secured from the Van de Graaf machine in the Collis P. Huntington Memorial Hospital.

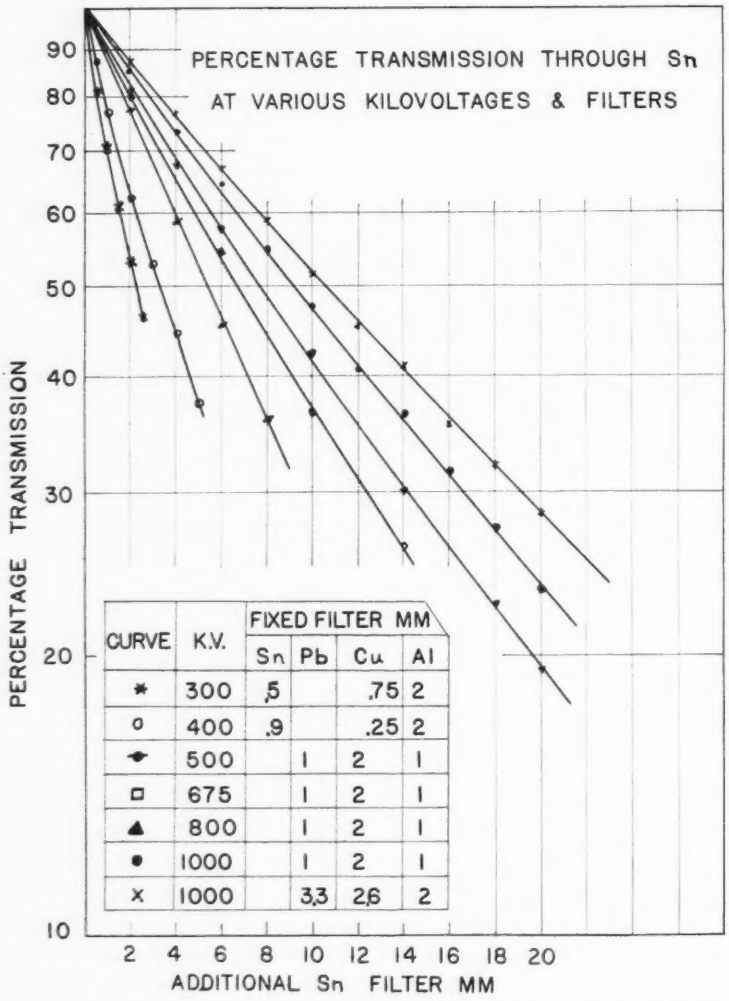
PERCENTAGE TRANSMISSION THROUGH Sn
AT VARIOUS KILOVOLTAGES & FILTERS
PERCENTAGE TRANSMISSION
90
80
70
60
50
40
30
20
10
2 4 6 8 10 12 14 16 18 20
ADDITIONAL Sn FILTER MM
CURVE | K.V. | FIXED FILTER MM | | | |
Sn | Pb | Cu | Al
* | 300 | .5 | | .75 | 2
o | 400 | .9 | | .25 | 2
500 | | 1 | 2 | 1
□ | 675 | | 1 | 2 | 1
▲ | 800 | | 1 | 2 | 1
• | 1000 | | 1 | 2 | 1
x | 1000 | | 3.3 | 2.6 | 2

Fig. 5. Percentage transmission through tin at various kilovoltages and filters.

SUMMARY

Absorption curves in lead, tin, and copper are given for the radiation at 1,000 kv. from an x-ray tube actuated by a Van de Graaf generator. For clinical use an added filter of 3.3 mm. Pb, 2.6 mm. Cu, and 2 mm. Al is used. This results in a mean wave length of 0.021 Å. as determined from half value layers in lead, tin, and copper, and a value of dose per minute per milliampere of 47 r in air, at a treatment distance of 70 cm.

It is a pleasure to extend my thanks to my assistants, Messrs. H. S. Baxter and R. F. Cowing, for valuable aid in the construction of apparatus and the taking of data.

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RECOVERY FOLLOWING HUMAN OVARIAN IRRADIATION[1]

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From the Department of Radiation Therapy of the Western Pennsylvania Hospital

TWO of the fundamental but probably least well understood effects of irradiation upon living tissues are the processes of destruction and repair. In some organs and tissues it is difficult, if not impossible, to determine the degree of recovery which has taken place following radiation therapy. But human ovarian tissue is one in which return of function can be observed by the re-establishment of the menstrual and child-bearing functions.

The production of temporary sterilization by irradiation is a well-recognized and safe clinical procedure used throughout the world. Radiologists are familiar with the variability of the ovaries in relation to x-ray sensitivity, and with the strong recuperative power even a small amount of ovarian tissue may possess. It has been our custom to consider 500 r delivered to the ovaries sufficient to produce permanent castration in the majority of patients. However, a young individual may require a larger amount than a patient approaching the menopause because of the greater power of recovery in young ovaries. We all know that some of our patients menstruate again after varying periods of amenorrhea following the customary roentgen castration exposure.

The effect of irradiation on future offspring is not well understood. Whether an ovary irradiated so as to suppress the menstrual phenomenon for an extended time can recover to produce healthy ova capable of fertilization and development into normal children is not so definitely proved, but such occurrences, as reported here and elsewhere (2 and 10), tend to bear out this assumption. After studying several hundred pregnancies, Murphy (6) stated that ovarian irradiation, prior to fertilization, has no detrimental influence upon the health or development of subsequent children.

Riboni (7) reports the case of a 27-year-old woman who was subjected to presumably permanent roentgen sterilization for a freely bleeding fibroid. She noticed mild menopausal symptoms and no menstrual periods for two years, at the end of which time she became pregnant and gave birth at term to twins. One was born dead after forceps delivery; the other was delivered spontaneously, and was in perfect health 15 years later. After 15 years of normal menstrual periods, the fibroid again caused symptoms and was removed surgically.

Kaplan (4) describes a 30-year-old woman with severe acute pulmonary tuberculosis, who received roentgen therapy to produce a therapeutic abortion. Since this did not occur in six weeks, a simple vaginal hysterotomy was done. She did not menstruate after the operation, but conception occurred ten months later. The pregnancy was allowed to go to term and a normal male child was delivered without difficulty. Fourteen months following birth, the child was healthy and normal in development.

Again, Kaplan (3) reports the case of a 36-year-old woman who was presumably permanently castrated by roentgen rays because of recurrent carcinoma in both breasts. She was amenorrheic for 14 months, but became pregnant and was aborted by evacuating the uterus through abdominal hysterotomy. Double ovum twins of normal ten weeks' development were found. The left ovary was large and cystic; the right small, hard, and fibrous. The left ovary showed two corpora lutea, one normal yellow body and the other cystic.

[1]Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

Schiller (9) reports the history of a woman, aged 43 years, who had never been pregnant. She had uterine fibroids, and, on account of profuse hemorrhages, artificial menopause was induced by roentgen rays. Six months later menstruation reappeared once and after this the patient became pregnant. The child was normal when 18 months old.

Rongy (8) also records a similar instance in a woman, 30 years of age, who had been married nine years but who had never been pregnant. Because of almost continuous vaginal bleeding, she received four applications of roentgen rays over the ovaries. The bleeding ceased and the menstrual flow did not appear again. She conceived two months after the treatments and was delivered spontaneously of a living male child weighing 8 pounds 4 ounces.

The case of a 33-year-old woman who was practically incapacitated because of menorrhagia is reported by Masson (5). The flow was only partially controlled with 400 mg.-hr. of intra-uterine radium application. Consequently, ten months later, a menopausal dose (992 mg.-hr.) was given, and the patient had no menstrual flow for over three years. She became pregnant, but because of hemorrhages a total abdominal hysterectomy was performed and a threatened rupture of the uterus was found. The condition of the fetus is not recorded, but the patient made an uneventful recovery.

Blass (1) presents the case of a malignant epithelial neoplasm of the ovary in a 17-year-old girl in whom no disturbance of the menstrual cycle was produced with three courses of post-operative roentgen therapy within a period of six months. Smith (11) reports two cases of uterine cancer, aged 38 and 27 years, respectively, in whom intensive radium therapy produced clinical cures of over eight and nine years, with return of ovarian function after six years and six months and five years and eight months, respectively.

Steiger (12) reports a pregnancy following x-ray treatment of a fibroid uterus reaching almost to the umbilicus, in a woman 39 years of age, after amenorrhea of four months' duration. This resulted in a normal nine-pound baby, well and strong one year after birth. He cites a case of Pankow, occurring after amenorrhea of 18 months. Three years after birth the child was undernourished as a result of war conditions. Zangemeister reported a normal child following a six-months' amenorrhea. Probably there are other cases reported under different subjects, and doubtless many have never been published.

This study includes two unusual clinical experiences following ovarian irradiation. The first showed exceptional resistance of an ovary to roentgen rays, although the microscopic study obtained after surgical castration was normal. The second is a five-year "arrest" of a malignant epithelial neoplasm of the ovary in a young woman. She had return of the menses two years after post-operative roentgen therapy of the remaining ovary, followed by the birth of a normal child, now nearly one and one-half years old. These cases show how complex the biologic reactions of the ovary may be, and the tremendous recuperative power the ovary may have.

Case 1. Miss S., a registered nurse, aged 37, was in good health until a hypodermic needle was broken off in her right arm in 1930. It was removed after some time and she developed an abscess at the site and another on the inner surface of the right elbow. This was followed by several series of metastatic abscesses throughout the body. These were always worse at the menstrual periods, requiring hospitalization and incision and drainage under anesthesia, with cultures showing the usual pyogenic organisms. Autogenous vaccines and female sex hormone therapy gave no relief, and the series occurred about every three to five weeks. Because of the definite relationship to the menstrual periods, the patient was given a temporary castration exposure of x-rays elsewhere (amount not known) in February, 1935, and there were no periods or abscesses for eight months. Menstruation returned in October, 1935, and the abscesses reappeared likewise.

The menstrual periods had always been irregular. They began at 16, occurred at two- or three-week or six- or seven-week intervals, and usually lasted one week, accompanied by severe pain and scanty flow. In the past history the patient had an acute attack of appendicitis in April, 1922, with removal of the appendix. The uterus, tubes, and ovaries were normal at that time. Two years later, in April, 1924, the patient had an operation to remove adhesions which produced partial intestinal obstruction. At that operation a cystic right ovary was removed which showed numerous follicular cysts and several corpora lutea microscopically. This procedure failed to have any effect upon the irregular menstrual periods. Three months later a second operation for acute intestinal obstruction was performed. She had two subsequent attacks of intestinal obstruction, not severe enough to require operation.

Altogether the patient was admitted to the Western Pennsylvania Hospital 13 times between 1932 and 1937, for incision and drainage of multiple abscesses, most of which occurred just before the onset of a menstrual period. For some reason, the immunity of the skin was lost at those times. The abscesses were always large, deep, and exceedingly painful, accompanied by considerable toxemia. In December, 1935, a positive blood culture of *Staphylococcus albus*, the same organism recovered from several of the deep abscesses, was obtained, and the patient almost lost her life, but responded to multiple blood transfusions.

In January, 1936, it was decided to give the patient a permanent sterilizing exposure of roentgen rays. She was 5 feet 11 inches (177.5 cm.) tall and weighed 101 pounds (46 kg.), calipering 15 cm. anteroposterior recumbent. She received 900 r (air measurement, 200 kvc., 0.75 mm. Cu plus 2 mm. Al) to each of two portals, 12 × 15 cm., over the anterior and posterior pelvis in six days, giving two areas 200 or 300 r each per day. The ovary received approximately 700 r. There was little radiation sickness, and the patient had no periods or abscesses for eight months, but the abscesses recurred a few days before she started to menstruate in September, 1936. She correctly foretold the onset of the menses by the appearance of the first abscess. She was hospitalized three times for incision and drainage and in December, 1936, a larger quantity of radiation was given. This consisted of 1,500 r to each of two portals, as before, in nine days. The patient suffered considerable radiation sickness. The ovary received approximately 1,200 r, which failed, however, to produce permanent sterilization, the patient menstruating as usual in March and May, again preceded by abscess formation. Consequently with the return of abscesses and periods a panhysterectomy and left salpingo-ophorectomy was performed in June, 1937. Considerable scar tissue was found in the pelvis. The gross appearance of the left ovary was normal. The microscopic report showed, "senile atrophy of the uterus. Fibrosis and atrophy of the ovary." Nothing was found to account for the peculiar resistance of this remaining ovary to irradiation. The patient continues in perfect health to date (November, 1938), without a single abscess for 17 months.

Case 2. Miss E. I., an Italian housemaid, 21 years of age, was in excellent health until October, 1933, when she began to lose appetite and had a "bloated feeling" in the region of the umbilicus. There was gradually increasing enlargement and pain in the abdomen, suggesting pregnancy, when she was admitted to the Western Pennsylvania Hospital in March, 1934. However, her menstruation had always been regular, beginning at the age of 13, without endocrine abnormalities. She had lost 20 pounds (9.1 kg.) in weight in the past five months, which represented 15 per cent of her usual body weight.

The past and family histories were irrelevant.

Physical examination showed a chronically ill, young Italian girl, 5 feet 4 inches (160 cm.) tall, weighing 115 pounds (52.3

kg.). The rest of the examination was not significant except for the abdomen, which was filled with a smooth, rounded, symmetrical, firmly fixed mass about the size of a full-term pregnancy. It was not tender or fluctuant. The cervix was high in the pelvic cavity, but of normal consistency. The fundus could not be outlined separate from the mass, and it did not encroach upon the rectum. The clinical impression was an ovarian cyst, possibly malignant.

The serologic test for syphilis was negative. The hemoglobin was 80 per cent, the red blood cell count 4,190,000, and the white blood cell count 8,500 with a normal differential formula. Numerous urinalyses showed a trace to 3 plus albumen, with 10 to 30 white cells per high power field and occasional casts. The systolic blood pressure was 145, the diastolic 95.

At operation a large, semi-solid, cystic mass arose from the left side of the pelvis and extended to the under surface of the liver. A small amount of free, straw-colored fluid was present. The uterus, right tube, and ovary were normal. The tumor, with tube attached, was removed without rupture and weighed 13 pounds (5.9 kg.). Because the gross appearance of this tumor suggested a dermoid, the right ovary was not removed. The patient made an uneventful recovery.

The pathologist's report was as follows:

"Specimen is a nodular, ovoid mass measuring 36 × 25 × 20 cm. and weighing 13 pounds (5.9 kg.). The external surface is coarsely lobulated, smooth and gray mottled with red. The cut surface varies from gray, red and gray to yellow, the latter areas being very soft and containing ragged cystic spaces filled with cloudy fluid. All tissue is fairly soft. The more firm areas are gray with small yellowish-gray patches. The soft areas are gray and appear somewhat papillary, evidently due to the partial breaking down of tissue which finally becomes complete in the ragged yellow areas. *Microscopic diagnosis:* Solid carcinoma of the ovary. Note: The complete lack of any detectable architecture and of any type of differentiation of the cells making up the tumor may lead one to designate this growth as an 'embryonal' type of carcinoma."

This tumor has also been called by some pathologists an atypical granulosa-cell tumor (Fig. 1).

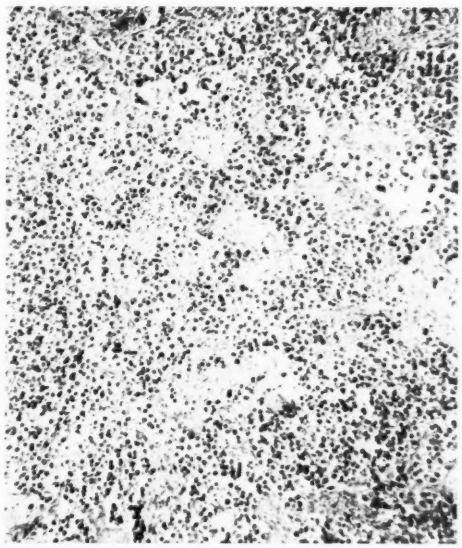

Fig. 1. Case 2. Typical low-power photomicrograph of malignant epithelial ovarian tumor showing embryonal characteristics. The cells are loosely and indefinitely arranged, and show variability in size, shape, and intensity of staining.

On the eleventh post-operative day high voltage roentgen therapy was started, because of the malignant nature of the tumor. The patient received 800 r (air measurement, 200 kvc., 0.75 mm. Cu plus 2 mm. Al) to each of four portals, 12 × 17 cm. about the pelvis, and to two portals, 7 × 18 cm. over the retroperitoneal regions, in three successive daily exposures, giving two portals 200 or 300 r each per day. Since she calipered 14 cm. from front to back recumbent, the estimated dose to the remaining ovary, assumed to be in the mid-pelvis, was 640 r. With this quantity of radiation the patient did not menstruate for two years.

Two months following irradiation the patient had severe hot flashes which were relieved by applying 300 r with the same technic as above to each of two temporal fields over the pituitary gland. She was followed in the Tumor Clinic at regular

three-month intervals, where she showed steady improvement. In the meantime she was married, but believed herself sterile. After an interval of amenorrhea for two years, she had three normal periods in February, June, and August of 1936, and a four months' pregnancy was diagnosed in February, 1937. Since the obstetricians predicted a normal course and infant, she was allowed to go to term. The pregnancy and delivery were without incident and a normal female infant, weighing 6 pounds 4 ounces, was born in July, 1937. The mother and child remain in perfect health at present (November, 1938), and the child is normal in every way. The mother has had three normal menstrual periods—in March, September, and November, 1938.

SUMMARY

1. The first patient demonstrated an unusual loss of immunity to serious cutaneous and subcutaneous infections definitely related to ovarian dysfunction, and a marked resistance of a microscopically normal ovary to roentgen rays.

2. A five-year clinical cure of a malignant epithelial ovarian neoplasm in a young woman is reported. This patient became pregnant after being amenorrheic for two years following post-operative roentgen therapy, and gave birth to a normal child.

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DISCUSSION

Milton Friedman, M.D. (New York City): The ovary is essentially a radiosensitive organ but under certain conditions it is radioresistant. The ovary of young women is radioresistant and requires considerable radiation to castrate permanently. However, the age of the patient is not always an indication of the potency of the ovary.

It is not uncommon to have women continue to menstruate beyond the age of 50 or 55. I recently observed a 70-year-old woman who had had an apparent menopause (cessation of menses), but without symptoms, twenty years ago at the age of 50. She complained of recurrent uterine bleeding, and was found to have corpus carcinoma. Her uterus, and both tubes and ovaries were removed. She immediately went into a typical menopausal picture of nervousness, hot flushes, etc. In this patient there probably was a continuation of ovarian activity beyond clinical menopause.

The frequent absence of menopausal symptoms after the cessation of menstruation is, in many instances, suggestive evidence of residual ovarian activity. It is not uncommon in those patients to find on bio-assay that there is some residual estrin present in the blood and urine, and that the prolan does not increase compensatorily.

The clinical importance of this point

arises when we are castrating a woman near the age of menopause for marked benign breast hyperplasia or marked cystic disease of the breast causing symptoms of discomfort. A simple castration dose, under those circumstances, will occasionally not be followed by a complete resolution of the breast hyperplasia, and it has been our experience, or our conclusion, that a double castration dose is necessary—at least 800 to 900 roentgens delivered to the ovary—in order to completely eradicate all ovarian activity. We have probably all seen other instances in which a larger dose than usual was found necessary to eradicate a particular ovary.

Further evidence of the persistence of ovarian activity post-menopausally is found in women who have carcinoma of the breast and at the same time cystic disease. Colonel Whitmore, in his exhibit upstairs, displays one such case of a 70-year-old woman who has a carcinoma of the breast together with cystic disease. In that breast are also found areas of lobular hyperplasia of the terminal buds, suggesting active estrin influence. When you examine the epithelial lining of the more or less quiescent cystic areas, you find marked evidence of proliferation. This does not imply that the estrin was responsible for the epithelial proliferation in such cystic areas, but it is likely that had that patient been deprived completely of any estrin influence on the breast, either at physiologic menopause or by castration, the total amount of epithelial hyperplasia would have been considerably diminished.

HYMAN I. TEPERSON, M.D. (Brooklyn, N. Y.): I might add that it has been my experience—and probably some of you have had a like experience—that in cases in which women are subjected to radium treatment preceded by curettage for hyperplasia of the endometrium, in order to suppress their menstrual function, a number of these cases did not respond to the radium treatment.

These cases were subsequently sent to us by the gynecologist who performed the operation and radium insertion, for additional radiation to the pelvis. We have noted that some of these cases did not respond as expected.

A repetition of a course of therapy at some interval likewise gave discouraging results.

It had occurred to us that, as Dr. Jenkins[1] has brought out this morning, there must be some inter-relationship between glandular functioning. We have investigated some of these cases in relation to thyroid and adrenals. We have found a number which proved to be hypothyroid cases, some were hyperthyroid, and in one case we found a hypofunction of the adrenals.

The complementary administration of thyroid to these hypothyroid cases immediately gave a response which we should have received with radiation therapy alone. These women who previously had not ceased their menstruation with radiation, both radium and x-ray, immediately responded and ceased their activity after thyroid or adrenal therapy, as the case might have been.

HENRY SCHMITZ, M.D. (Chicago): The presentation of this paper has a great deal of scientific interest. One might say that it is against all known biological laws that recoveries occur as described. However, such a single instance does not prove the law, but rather an exception. May I cite a case which bears on this subject.

A young woman had a chronic cervicitis and was treated at another hospital with radium, which brought about amenorrhea. About six years afterward this woman, without ever menstruating, became pregnant. She was then delivered at term by Cæsarian section, due to fibrotic stenosis of the cervical canal. Five years later she again became pregnant, though she had not menstruated. In other words, here was a patient who had a permanent radia-

[1] "The Treatment of Hyperthyroidism with a Consideration of Other of the Ductless Glands as a Trigger Mechanism: Based upon the Observation of 360 Cases," by I. Warner Jenkins, M.D., F.A.C.P. RADIOLOGY, **32**, 340-345, March, 1939.

tion amenorrhea and, in spite of that, became pregnant twice.

The structures in the ovary which we must consider in the radiation therapy are three: the primary follicle, which is a resting follicle; the maturing follicle, which is differentiating, and finally the matured follicle, which has reached complete growth maturity. The application of radiations destroys the maturing follicle first, the resting primary follicle next, and the mature follicle, or corpus luteum, last.

If, for instance, the radiation is given during the last half of the menstrual cycle when the follicle has matured, one may be sure that the patient is going to menstruate, but she will probably not menstruate the month afterward, as follicles will not mature any more. Ovulation will thereafter not occur again because all the follicles, the resting and maturing ones, will have been destroyed by the x-ray. If menstruation recurs later on after one or more years, it must be assumed that the primary follicles had not been totally destroyed and, therefore, re-exert their function.

The fact that an apparently healthy child has been born of a woman whose ovaries had been subjected to radiation does not mean that the next generation of this child, when he or she may have offspring, may not show mutations and malformations due to radiation injuries of the chromosomes or genes of the ovum.

Therefore, it is extremely important to be sure that when we do castrations we do them as perfectly as we can; rather use a much larger dose than we would ordinarily, than to subject the patient to the possibility of having a child born after the irradiation of the ovary.

Another point I wish to discuss has to do with the influence of endocrines on the breasts, which is so often brought up. The breast is entirely under the function of the hormones of the ovary as well as the pituitary. The hormones of the pituitary are the follicle-stimulating and the luteinizing hormones. The follicle hormone brings about development of the primary ovarian follicle and the luteinizing hormone causes the granulosa cells to luteinize. Proliferating and secreting changes are rhythmically developed in the functionating epithelium of the breasts as in that of the endometrium.

If a patient has been castrated, whether surgically or radiologically or has passed the menopause, the follicle-stimulating hormone alone remains active. The hormone may be extracted from the urine and blood. And this hormone is responsible for the development of the flaccid small breasts seen in mature women to the larger and full breasts seen during the periods of senility or after castration.

The amounts of follicle-stimulating and luteinizing hormones thrown into the body during ovulation are so small that they cannot produce permanent proliferations if functions are normal. Hence one need not worry to use the hormones in substitution therapy.

The luteinizing hormone may be more important in the pathology that one sees in the breasts.

GENTZ PERRY, M.D. (Evanston, Ill.): I did not expect to report this case but Dr. Jacox's very interesting and practical paper prompts me to add this case report.

The case I wish to report was a young colored woman, Mrs. A. L., referred to me by a local physician, for radiation therapy of the breast carcinoma which the pathologist reported as an ordinary adenocarcinoma. At that time the patient was 36 years of age. She had been married 13 years and had been pregnant twice, with a miscarriage about the fourth month each time. Both blood and spine Wassermann tests were negative. The carcinomatous development had been going on for about five months and was quite well advanced with beginning ulceration of the carcinomatous mass, which was about six by seven centimeters in size. There were two palpable axillary lymph glands on that side.

We gave the patient 6,463 r through five portals of entry—200,000 kv.—using a Thoraeus filter equivalent to 2 mm. of

copper at 50 cm. distance. That radiation therapy, by the way, caused axillary nodes to disappear entirely and reduced the size of the tumor mass very much, but it was *immediately* followed-up—as we do in all cases—by simple mastectomy, a surgical removal of the remainder *of the mammary gland only* without invading the axilla.

The end-results appeared to be an eradication of the carcinomatous invasion, and following the stereotype plan of trying to prevent recurrence, we gave 500 r of 200 kv. through the same Thoraeus filter to each of the ovaries, with the idea of, at least partially, sterilizing the patient or bringing on the menopause.

About seven months after treatments to her ovaries, which were given after she had had her mastectomy, she again menstruated and kept on menstruating regularly for four months until she again became pregnant and was delivered of a normal full-term baby weighing 6 pounds 3 ounces, that is now approximately seventeen months old. The child is perfectly normal and one of the features of the case that was rather agonizing to us physicians was that the mother persisted in nursing the baby on the other breast, which she did for some three months.

She has not shown any signs of recurrence and is again menstruating normally. Her age at the present time is 41 years. Her healthy child now weighs about twenty-eight pounds.

HAROLD W. JACOX, M.D. (*closing*): I wish to thank the discussants for their help. I really did not realize there was this much interest.

I could not give all the references in the paper; I tried to collect as many cases as I could that bore on this subject. However, Dr. Schmitz has raised such a pertinent question I would like to add this.

He said we do not know what is going to happen to the second generation. That is perfectly true. The work has been done on rats and other laboratory animals and that is a fine thing; we ought to know about that. But we do not know what effect alcohol and certain poisons are going to have on the second generation, either. Perhaps poisons and irradiation act somewhat the same in producing these later damages.

A PLEA FOR THE MORE FREQUENT USE OF THE LATERAL ROENTGENOGRAM IN THE DIAGNOSIS OF PREGNANCY

By MAXIMILIAN J. HUBENY, M.D., F.A.C.R., F.A.C.P., *and* PERCY J. DELANO, B.S., M.D., *Chicago*

From the Department of Roentgenology of the Cook County Hospital

As early as 1896, the roentgen ray was suggested as an aid in the diagnosis of pregnancy, but early attempts in this direction were rather disappointing. According to Case (1), Levy-Dorn, in 1897, showed the skull of a fetus in a roentgenogram, but exposures with the technic then available often required an hour and a half, or more!

So little was known about the roentgenographic characteristics of pregnancy that, in 1908, Bouchacourd concluded that the demonstration on a plate of a fetus *in utero*, might well be considered a sign of fetal death.

According to Hess (2), ossification of the fetal skeleton begins at the seventh week. Jungmann, by the use of the Potter-Bucky diaphragm, has recognized pregnancy as early as the eighth week.

Bartholomew, Sale, and Calloway, from repeated examinations, have decided that diagnostic films can be expected in about one-third of the cases, by the beginning of the fifth month.

Though the use of the roentgen ray is frequently stressed to-day for its value in early diagnosis (3), yet the Aschheim-Zondek test, with its approximate 97 per cent accuracy, would seem to render

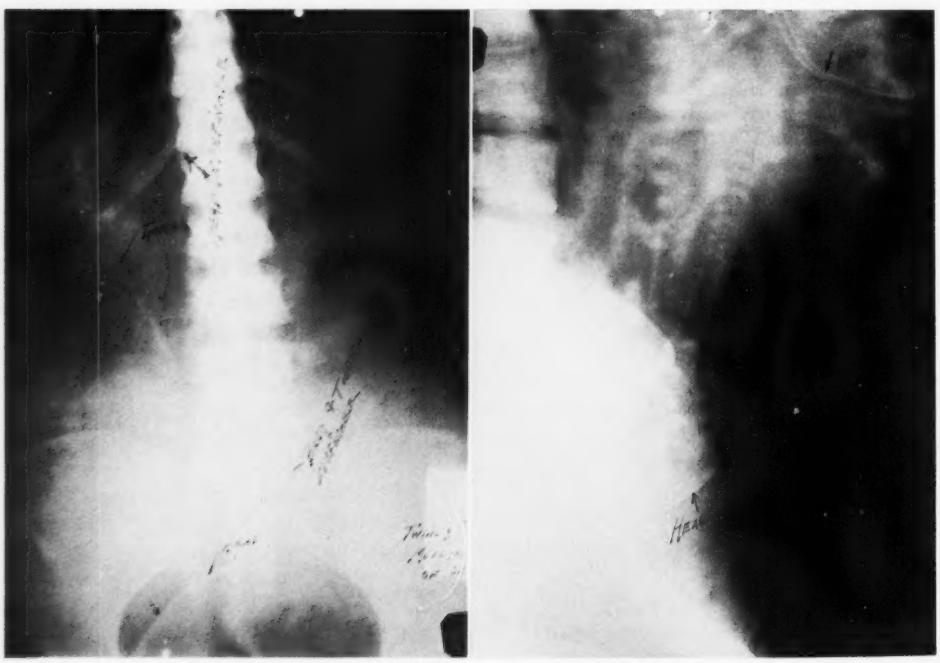

Fig. 1-*A*. Fig. 1-*B*.

Fig. 1-*A*. One fetal head in pelvis, but no accompanying skeleton. Also, a fetal skeleton present without accompanying head. Absence of the above is probably due to movement of the unfixed parts of the fetus, the head of which shows in pelvic inlet.

Fig. 1-*B*. Study of films *A* and *B* clarifies doubt of multiple pregnancy.

most unwise the employment of such hazardous procedures as pneumoperitoneum and the injection of contrast material.

Brault (6) urges more frequent examinations and believes the effect of the rays on the fetus to be negligible. Moloy and Swenson (2) estimate the total radiation reaching the ovary and developing fetus, from the average series of films, to be 5.3 r. Eisaman (8) and Reinberger and Russel (5), in comprehensive reviews of the subject, urge more intensive study of pregnancies through roentgenograms, but inject a timely note of warning as to the limitations of this type of examination.

In reviewing large numbers of films in pregnancy cases at the Cook County Hospital, we have been repeatedly struck with the vast amount of information to be gleaned from the lateral projections, and have thought the matter worth commenting upon, since, until rather recent times, the lateral projection has received somewhat less attention in the literature than the supine and prone positions, or stereoscopic elaborations of each.

Shäfer (7) has often emphasized the value of the lateral view, and Pickhan (4) has worked with increasing filtrations in the lateral position, using in some cases as much as 0.6 mm. of copper to determine what could be done by making the ray more penetrating. Sante (11) calls attention to definite advantages possessed by the lateral views. Roberts (9) illustrates a striking case in which a lateral view shows a triple pregnancy: two of the heads lie in the same vertical plane and must indeed have led to ambiguity in an anteroposterior scout film.

In the early months, while the fetal skull or other identifiable part is still within the maternal pelvis, the anteroposterior, or in some cases the prone, positions are doubtless the ones of choice. A lateral view here would merely mask the

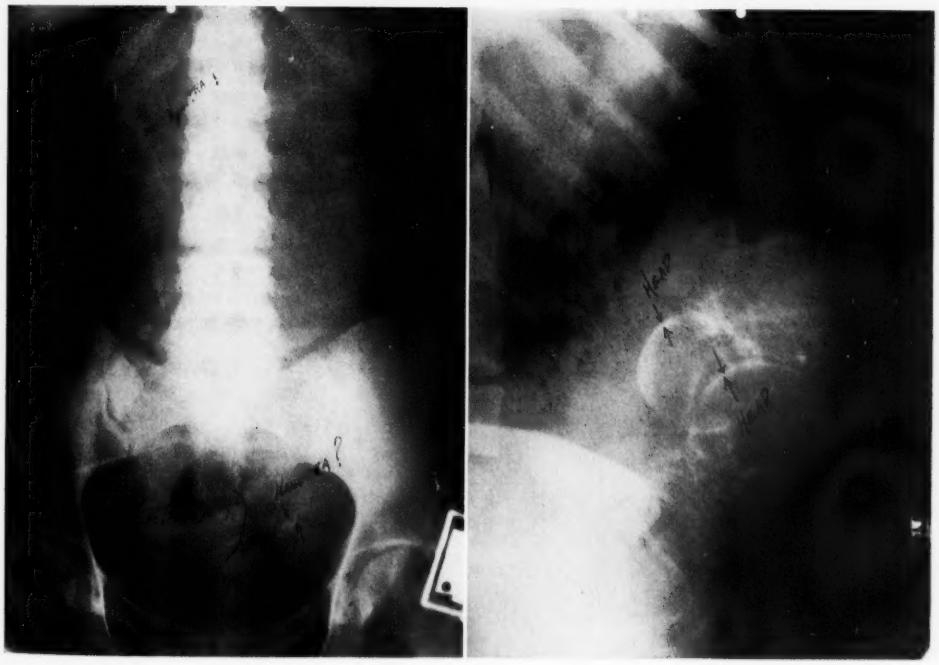

Fig. 2-*A*. Fig. 2-*B*.

Fig 2-*A*. No definite findings of pregnancy.
Fig. 2-*B*. Twin pregnancy demonstrable; one breech in pelvis, one in fundus; heads together.

fetal outline beneath the dense shadows of the innominate bones. Goethals (10) interprets stereoroentgenometric results with the aid of a dummy.

It is in the later months, when the fetal parts have risen out of the pelvis, that we have found increasing utility in the lateral exposure.

Certain technical procedures, in connection with roentgenography in pregnancy, have come to be a part of our routine, because their value to us has been so frequently evident. First, the abdominal binder has come to be considered rather indispensable. We prefer it to other methods for compression of the abdomen and immobilization of the fetus. The prone position we dislike for later cases, since it is not without danger, and we believe the same principle applies in lesser measure to the practice of employing a pneumatic compression bag. Next, we instruct the patient to take a breath and hold it; we then wait about two seconds before making the exposure. We have found this device one of the best for stilling fetal movement.

In addition to the anteroposterior and lateral views, we often take one or more obliques.

Three cases are illustrated here in which the diagnosis probably would have been missed had we had only anteroposterior views. It might be mentioned, in passing, that the complete series taken in the larger diagnostic clinics are often dispensed with in smaller centers, and one film, which is usually an anteroposterior, taken. This is regarded as a scout film, and the most informative of any which could be employed. It is to this use of the anteroposterior view that we call particular attention.

In Figure 1, *A* and *B*, we are illustrating

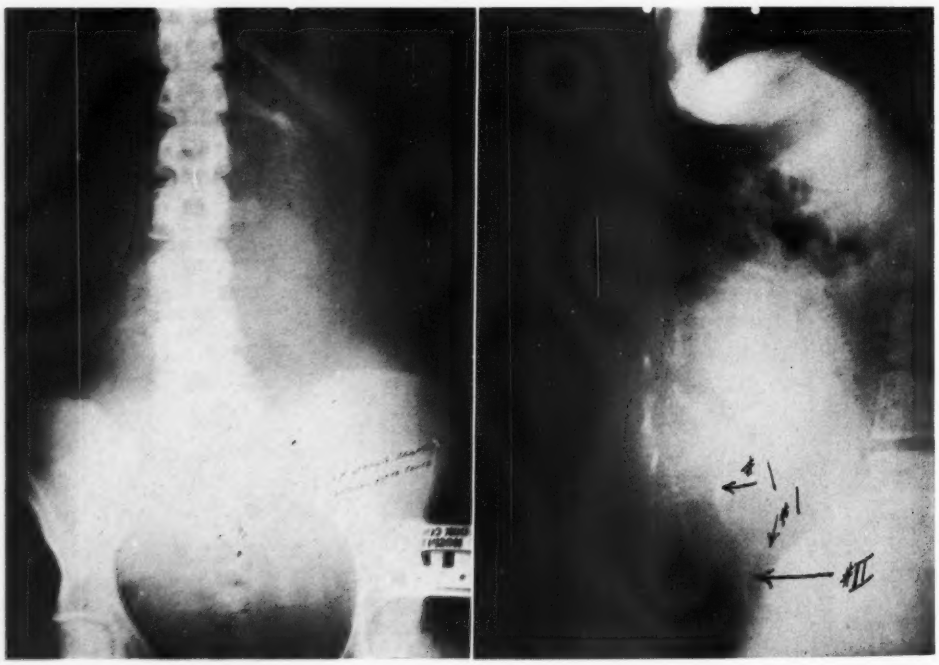

Fig. 3-*A*. Fig. 3-*B*.

Fig. 3-*A*. No definite findings of pregnancy.

Fig. 3-*B*. Arrow No. 1: Head outline of one fetus. Arrow No. 2: Thoracic cage of second fetus. Numerous extremity shadows present. Twin pregnancy demonstrable; one breech in pelvis, one in fundus; heads together.

a twin pregnancy. The anteroposterior view shows the head of one, and the thorax and major portion of the spine of the other fetus. Very misleading! The lateral view shows the true state of affairs, in a relatively advanced case.

The second set of illustrations, Figure 2, *A* and *B*, shows an anteroposterior view which is essentially negative, so far as definite evidence of fetal parts is concerned. The diagnosis of pregnancy would probably be altogether missed from this film alone. The lateral indicates a twin pregnancy—one breech in the pelvis, one in the fundus, and the heads together. This is probably about a six months' pregnancy. The history was indefinite.

Figure 3 shows an anteroposterior view which we do not think is very suggestive of pregnancy. The lateral view again shows two heads with good detail.

SUMMARY

We believe that the lateral roentgenogram has not received sufficient emphasis for its value in the diagnosis of pregnancy.

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THE COMPUTATION OF DIMENSIONS IN PLANIGRAPHY WITH MATHEMATICAL INSTRUMENTS

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BY planigraphy we mean the visualization, localization, or mensuration of objects occupying specific planes in the radiograph. Certain standard conditions, namely, target film distance and target shift distance are easily established. Graphical methods of planigraphy have been presented by Kaufman (1, 2, and 3). We feel that while this method is adequate and accurate, a more simple and more rapid method could be applied. When standard conditions are used for each case, mathematical tables for computation as well as certain well known precision instruments such as the pantograph and planimeter are applicable. The derivation of tables and application of mathematical instruments will be presented.

Kaufman (1, 2, and 3) has given in three articles a very clear and detailed description of the methods of planigraphy and has shown methods of graphical reconstruction of the planes produced. In this paper we wish to outline methods of localization and plane production which are not dependent on graphical methods, and to show the application of the use of mathematical instruments to this problem. It is assumed that the reader is fully conversant with the descriptions of Kaufman so that the methods and relationships produced in planigraphy will not be reviewed here.

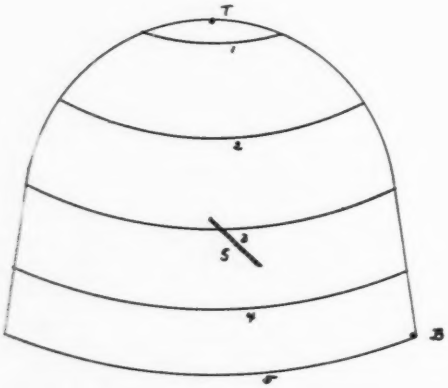

Fig. 1.

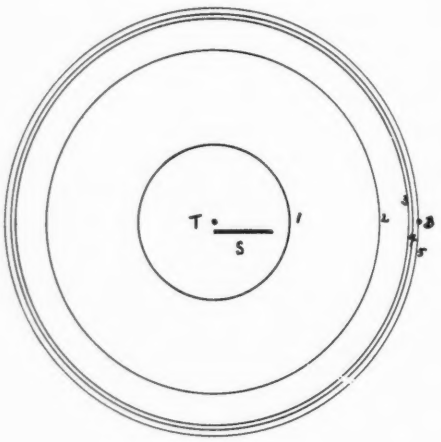

Fig. 2-*A*.

Fig. 1. This is a drawing of the model used in this work. It illustrates the levels of the rings, their markings, the markers for top and bottom, and the central mass of solder placed for localization.

Fig. 2-*A*. This shows the projection of the rings of the model when taken with target above the axis of the model.

The degree of spread of a point in space is determined by the target shift and the height, h, of the point above the plate. Kaufman has drawn graphs to illustrate this relationship. For purposes of computation the computed values for shift, S, for three target shifts, 7.5, 15, and 22.5 cm., are recorded for planes at intervals of 2 cm. above the plate. H, the tube height, is taken as 80 cm. As an aid in interpolation

the value $\Delta S/\Delta h$ for each pair of planes is listed. Numerically, this is equal to the change in shift per centimeter in the region and corresponds analytically to the slope ds/dh for the shift height curve or standard depth curve of Kaufman. Since the beams from the x-ray tube diverge, the image on the plate is increased by projection by a factor which is equal to $H/(H\text{-}h)$. Consequently, all linear measurements on the plate must be multiplied by a factor which is unique for each plane in order to convert the measurements to the true distances in the level of the plane of the object radiographed. This factor is numerically equal to $(H\text{-}h)/H$ and is recorded in Column F of Table I. The area projection is changed by a factor equal to the square of the linear change and is recorded in Column F^2. The changes in dimensions due to divergence of the beam are not to be confused with the shift produced by moving the target. To illustrate the practical use of this table, the methods of reconstruction and determination of planes and localization of objects are outlined herein. This work was done on a wax model (Fig. 1). The levels were marked by wires encircling the object approximately 2 cm. apart and parallel to the base. An irregular piece of solder was embedded in the wax for localization of objects and the top and bottom of the mass were marked by small wires embedded in the wax. The results obtained by planigraphy are illustrated in Tables II and III and are compared with distances actually measured on the model. The volume was determined by displacement of water.

TABLE I

In the following table, h represents the height in centimeters of any plane above the level of the plate. S is the shift in centimeters produced on the plate, of the image projection, when the target is shifted T centimeters. S is listed for three standard shifts of the target, 7.5, 15, and 22.5 cm. After each value of S there is listed $\Delta S/\Delta h$ which shows the change in S per cm. of change of h in the region of plane height, h. This is used for interpolation. F is the factor by which linear measurements on the plate must be multiplied to give true linear measurements on the level of the plane considered the height of which is h. F^2 is the same conversion factor for areas. In this table the height, h, of the target is 80 cm.

h	S (T = 7.5)	$\Delta S/\Delta h$	S (T = 15)	$\Delta S/\Delta h$	S (T = 22.5)	$\Delta S/\Delta h$	F	F^2
0	.0	.09	.0	.18	.0	.27	1.00	1.00
2	.19	.09	.38	.18	.58	.27	.975	.950
4	.39	.10	.78	.20	1.18	.30	.950	.902
6	.61	.11	1.22	.22	1.82	.33	.925	.855
8	.83	.11	1.66	.22	2.50	.33	.900	.810
10	1.07	.12	2.14	.24	3.21	.36	.875	.766
12	1.32	.13	2.65	.26	3.97	.38	.850	.722
14	1.59	.13	3.18	.26	3.77	.40	.825	.680
16	1.88	.14	3.75	.28	5.62	.43	.800	.640
18	2.18	.15	4.37	.31	6.55	.46	.775	.600
20	2.50	.16	5.00	.32	7.50	.48	.750	.562
22	2.84	.17	5.69	.35	8.53	.51	.725	.525
24	3.21	.18	6.43	.37	9.64	.55	.700	.490
26	3.61	.20	7.22	.39	10.83	.60	.675	.455
28	4.04	.21	8.08	.43	12.12	.64	.650	.422
30	4.50	.23	9.00	.46	13.50	.69	.625	.392

This table provides a readily available chart to show the relationships between shift of points at different target shifts. It also lists correction factors for linear and area distortions produced by the divergence of the beams of x-rays.

Determination of levels of the arbitrary wire planes was carried out by superimposing the image of the marker on the bottom of the object in the two films and then measuring the shift of the rings which resulted (Figs. 2-*A* and 2-*B*). In the actual clinical use of this method it would be more convenient to superimpose objects in the same plane which were to be plane localized and then measure the separation of the base marker. Either method would give rise to values for shift referred to the base of the object radiographed (column Shift *b*., Table II). The measured distance of the base of the object was 2.1 cm. above the film, therefore by use of Table I it is found that the base markers should have

a shift referred to the plate of 0.20 cm. This value must be added to all the shifts referred to the base and give the true values for the shift referred to the plate. This is recorded in column Shift *p*. Using Table I irregular plane outlines, as would be found in actual cases, Kaufman (2) has described a polar co-ordinate method of reconstruction of the similar plane areas. This can be done accurately and rapidly by means

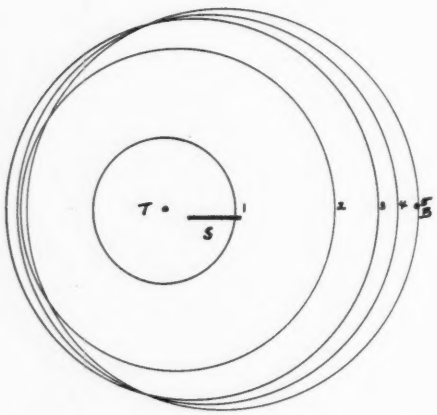

Fig. 2-*B*.

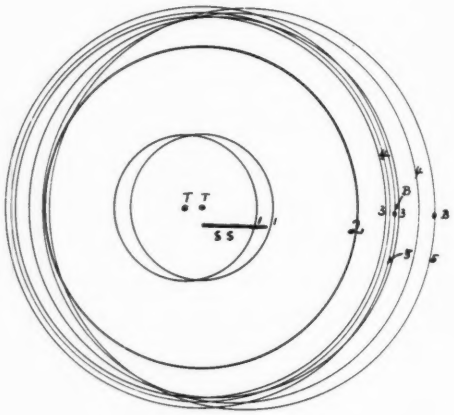

Fig. 2-*C*.

Fig. 2-*B*. In this the target has been shifted 15 cm., producing a shift of the rings from their concentric projection in Figure 2-*A*.

Fig. 2-*C*. This shows the use of multiple exposure for plane localization. The plate was shifted so that circle No. 2 was superimposed in the picture. All other circles are double.

again the values of shift from the plate and the values for *h* above the plate are found. Subtracting the distance of the base from the film the true heights of the planes from the base were computed, *h* from *b*. Under Column, *h* actual, the values measured on the object are recorded showing a satisfactory agreement.

For the determination of linear distances the diameters of the circles of the planes were chosen. In the second group in Table II the measured diameters are listed for the five rings. This is the diameter measured on either of the two films. From the values already obtained for the heights, *h*, of the planes, the values of *F*, in Table I, are found by interpolation and each diameter measured is multiplied by its respective factor. This gives the computed actual diameter of the rings and is in satisfactory agreement with the measured diameters. This represents a very simple problem when the planes are circles. For of the pantograph. The desired plane is found by the superimposition of its images, after which it is traced on paper. Its height is determined from its shift and the factor *F* interpolated from Table I. The pantograph arms are then adjusted so that a line of unit length on the tracing is diminished by an amount proportional to factor *F*. Then the tracing is outlined by the pantograph which reproduces the exact linear outline of the limits of the plane radiographed.

The determination of areas of planes is carried out in a similar fashion. The areas of the projected planes as seen on the plate are traced and their areas determined by means of a planimeter. If no planimeter is available, the area is outlined on a piece of good uniform paper, cut out, and weighed on an accurate balance. The weight of one square centimeter of the paper is then found and the area of the irregular surface computed. This is listed

in the third set of figures in Table II under area on p. From the previously computed heights of the planes the conversion factors for areas, F^2, are found by interpolation from Table I. These are multiplied by their respective plane areas, giving the computed actual areas of the planes. These are compared in the last column with the cross-section area of the planes measured on the model and are found to be in good agreement.

The determination of volume is made easily now with the previously determined data. In the second column under the determination of volume in Table II, are listed the actual computed areas taken from the values just found. The mean of two successive areas is then found and listed in the next column, representing the mean area of a small volume element. The thickness of these elements as found by the distance between the planes is then listed.

TABLE II

Target Shift 7.5 cm.

Level	Shift b.	Shift p.	h. from p.	h. from b. comp.	h. actual
Top	0.85	1.05	9.8	7.7	7.9
Ring 1.	0.85	1.05	9.8	7.7	7.9
Ring 2.	0.67	0.87	8.3	6.2	6.1
Ring 3.	0.43	0.63	6.2	4.1	4.1
Ring 4.	0.18	0.38	3.9	1.8	1.9
Ring 5.	0.00	0.20	2.1	0.0	0.0

Determination of Linear Dimensions

Level	Dia. on p.	Comp. actual dia.	Actual dia.
Ring 1.	3.91	3.42	3.50
Ring 2.	8.79	7.93	7.90
Ring 3.	10.44	9.66	9.75
Ring 4.	10.97	10.42	10.50
Ring 5.	11.05	10.75	10.75

Determination of Area of Planes

Level	Area on p.	Comp. actual area	Actual area
Ring 1.	12.0	9.2	9.6
Ring 2.	60.5	49.0	49.0
Ring 3.	86.0	74.0	74.3
Ring 4.	93.5	84.2	90.8
Ring 5.	95.8	90.8	90.8

Determination of Volume

Level	Comp. area	Mean area of element	Comp. thickness of vol. element	Vol. of vol. element
Ring 1.	9.2	0.0	0.0	0.0
Ring 2.	49.0	29.1	1.5	43.6
Ring 3.	74.0	61.5	2.1	129.0
Ring 4.	84.2	81.8	2.3	188.0
Ring 5.	90.8	87.5	1.8	157.5

Total, 518 c.c.
Actual 500: Diff., 3.6%

Localization of Points

Shift of upper end of solder	Shift of lower end of solder	Ring 3	
0.65	0.53	0.63	
Interpolation	upper end is 0.2 above Ring 3		Found by measurement 0.3
	lower end is 1.0 below Ring 3		Found by measurement 1.0
Distance from top to ring on p. 4.55		Actual comp. 4.28	Found by measurement 4.40
Distance of bottom to ring on p. 3.27		Actual comp. 3.14	Found by measurement 3.20

This table illustrates in detail the method of computation of height of planes, linear, area and volume computations. This is worked out for a target shift of 7.5 cm.

The product of the mean area of the element into its thickness gives the volume of the element. The sum of the elements gives the total volume of the region studied. This shows good agreement with the true volume. It is felt that the use of this method would be applicable for studying changes in volume of the sella, abscesses, and bone tumors.

The localization of points in the object can be determined from co-ordinates of the marker on the base or, more accurately, from surface landmarks near the plane of the points studied. This is illustrated in the last part of Table II which shows localization to the top and bottom point of the embedded solder. These points lie on either side of the level of Ring 3, having a shift of 0.65 and 0.53, while the ring has a shift of 0.63. Interpolating from Table I, it is seen that the upper end of the solder lies 0.3 cm. above the plane of Ring 3, while the lower end lies 1.0 cm. below it. On the x-ray film the distance of the ends

TABLE III

Target Shift 15 cm.

Level	Shift b.	Shift p.	h. from p.	h. from b. comp.	h. actual
Top	1.72	2.12	9.9	7.8	7.9
Ring 1.	1.67	2.07	9.7	7.6	7.9
Ring 2.	1.26	1.66	8.0	5.9	6.1
Ring 3.	.84	1.24	6.1	4.0	4.0
Ring 4.	0.39	.79	4.05	1.95	1.90
Ring 5.	0.0	.40	2.1	0.0	0.0

Determination of Linear Dimensions

Level	Dia. on p.	Comp. actual dia.	Actual dia.
Ring 1.	3.90	3.42	3.50
Ring 2.	8.78	7.90	7.90
Ring 3.	10.44	9.67	9.75
Ring 4.	10.78	10.22	10.50
Ring 5.	11.00	10.72	10.75

Determination of Area of Planes

Level	Area on p.	Comp. actual area	Actual area
Ring 1.	12.0	9.3	9.6
Ring 2.	60.4	49.0	49.0
Ring 3.	85.0	74.0	74.3
Ring 4.	92.0	83.0	90.8
Ring 5.	95.0	90.2	90.8

Determination of Volume

Level	Comp. area	Mean area of element	Comp. thickness of vol. element	Vol. of vol. element
Top	0	0	0	0
Ring 1.	9.3	4.6	0.2	0.9
Ring 2.	49.0	29.2	1.7	49.5
Ring 3.	74.0	61.5	1.9	116.8
Ring 4.	83.0	78.5	2.1	165.0
Ring 5.	90.2	86.6	1.9	164.1

Total, 496.3 c.c.
Actual 500: Diff., 0.7%

Localization of Points

Shift of upper end of solder	Shift of lower end of solder	Ring 3	
1.32	1.00	1.24	
Interpolation	upper end is 0.35 above Ring 3		Found by measurement 0.3
	lower end is 1.1 below Ring 3		1.0
Distance from top to ring on p. 4.68		Actual comp. 4.30	Found by measurement 4.40
Distance of bottom to ring on p. 3.00		Actual comp. 2.82	Found by measurement 3.20

This table is the same as Table II but worked out for a shift of 15 cm.

of the solder to the nearest approach of the ring was then measured and found to be 4.55 and 3.27 for top and bottom, respectively. These values were multiplied by their respective F values as computed from their known heights, h, from Table I, and the results are 4.28 cm. and 3.14 cm., respectively. These results are found in good agreement with 4.40 and 3.20 as measured on the model. There is a slight error introduced by the fact that the planes of the top and bottom of the solder are not the same as the level of Ring 3. This error is small and it becomes nearly zero in films taken with the control beam passing vertically down through the point in question. The same set of computations are outlined in Table III for the same test object, using a target shift of 15 cm.

When it is desired to reproduce a plane sharply by making two exposures on one film, the amount of shift for the film is found from Table I. Suppose a plane height, h, above the plate is to be radiographed. One film is taken with the target at Position 1 and then the target is shifted to Position 2, the shift being one of the three standard shifts. From Table I the expected shift for the image in plane, h, is read off and the plate moved over this distance. Then the second exposure is made. The desired plane will then be exactly superimposed in the film while other planes will not. This is illustrated in Figure 2-*C*. It was found that best results were obtained if the first radiograph was taken with the target directly above the region to be studied.

It was felt that the publication of Table I and illustrations would be an aid to those making use of planigraphy for exact measurements. Using a test object the dimensions of which could be accurately determined made it possible to check the accuracy of the method which, considering the possible errors, is quite satisfactory. It is our intention to apply this method to clinical studies and later to make a report of the findings. This preliminary report of the method was submitted with the hope that others could make use of Table I and outlined procedure.

SUMMARY

1. The authors present tables for use in planigraphy from which the necessary mathematical relationships can be read off directly. From this, the height of various planes can be determined for their respective shifts on the plate. Conversely, the degree of shift of the plate necessary for localization of any given plane can be found when it is desired to use the double exposure method.

2. Correction factors are listed to correct for distortion of linear and area relationships produced by divergence of the x-ray beam from the target.

3. The use of the pantograph and planimeter is outlined for the rapid reproduction of plane boundaries, areas, and the computation of volumes.

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PLANIGRAPHY—ITS APPLICATION TO THORACIC DIAGNOSIS[1]

By W. E. HOWES, M.D., *Brooklyn, N. Y.*

RECENT changes in the concepts of the treatment of pulmonary tuberculosis, associated with the great advances that have been made in thoracic surgery, serve as a challenge to the roentgenologist, who must now, more than ever, diagnose and localize anatomic and pathologic entities within the thorax. One way by which the roentgen diagnostician can meet this challenge is by the application of the principles of body section roentgenography often referred to as tomography, laminagraphy, stratisgraphy, or planigraphy.

Definition.—"Planigraphy is a method of roentgenographic projection of plane sections of solid objects" (8). This can be produced by the opposing excursion of the x-ray tube and the film in parallel planes which results in the blurring out of all detail except that of the images within the stratum of the fulcrum of the two opposed motions (Fig. 1). The amount of blurring depends mostly upon the amplitude and character of this motion (Fig. 2).

History.—The principle was first demonstrated as theoretically possible in a French patent by Bocage (1), dated June 3, 1921.

Most of the early research on the subject has been reported by Continental workers, namely, Vallebona (2), Bartelink (3), Ziedses des Plantes (4), Pohl (5), Grossmann (6), Chaoul (7), and others.

Andrews in his original essay (8) not only described the different technical procedures necessary for body section roentgenography, but also included a careful history of its development. In a later paper (9) he gave full mathematical and physical proof of the practicability of the planigraphic theory.

In this country, Mr. Jean Kieffer (10) was struck by the inability of the usual x-ray examination accurately to demonstrate pathology in the sternum. With this problem uppermost in his mind, he independently worked out the principles of body section roentgenography and designed an apparatus for its application which he called an "x-ray focusing machine." He applied for a patent in 1929 which was granted in 1934, but it was not until 1937 that Dr. Sherwood Moore (11) made up a working model of Kieffer's apparatus. Therefore, Dr. Moore's name should be linked with that of Andrews as among the first roentgenologists in this country to become interested in the principles and application of planigraphy.

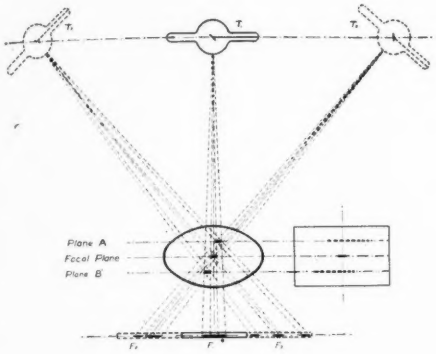
Apparatus.—The apparatus (Fig. 3) used in this presentation has a fixed tube target distance of approximately six feet. The tube and film move on parallel vertical planes with a fixed upward motion of the tube of 31 in., plus an additional side shift of four inches. The cassette carrier and tube are held in rigid association by a long bar. The focal plane of the exposure is changed by shifting the fulcrum on this rod. The amount of the opposite motion of the cassette carrier is partly dependent upon the relative position of the fulcrum to the x-ray tube and film. This particular type of motion is efficient in making planigraphic examinations of the thorax in that the maximum distortion is given the image in a vertical direction which tends to throw the ribs completely out of focus when they are not near the focal plane. On the other hand, the spine and heart shadows, being in the long axis of the motion, are not thrown laterally over the lung-fields. Ziedses des Plantes (4), Andrews (9), and Kieffer (10) have shown that spiral motion is best in obliterating shadows above and below the focal plane, this being particularly true in sectional x-rays of the skull.

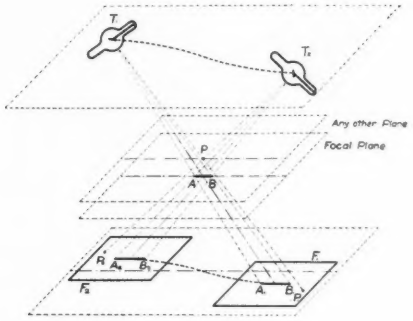
Thorax—A Model for Planigraphic Study.—The thoracic cage makes an excellent model for planigraphic study in that

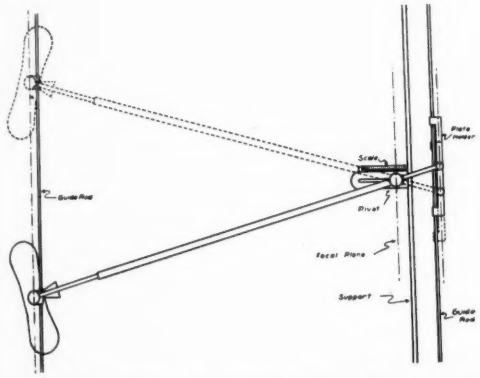
[1] Presented before the American Medical Association, Sect. on Radiology, June, 1938.

it is made up of a proportionately radiotransparent medium, the lungs, which are encased in a bony framework of spine, ribs, and sternum, while centrally within the mediastinum lie the heart, great vessels, the inability of a more exact anatomical differentiation. Planigraphic views often differentiate between bronchus, pulmonary vein, and pulmonary artery (7).

Indications for Planigraphy.—The







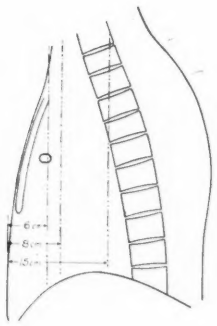


Fig. 1 (*upper left*). Schematic drawing demonstrating the theory of the planigraphic principle in one plane.
Plane A, above focal plane;
Plane B, below focal plane.

Fig. 2 (*upper right*). Schematic drawing demonstrating the type of motion used.
$A_1 - B_1$, $A_2 - B_2$—line in focal plane;
P_1, P_2—point outside of focal plane.

Fig. 3 (*lower left*). Schematic drawing illustrating mechanics of the apparatus used.

Fig. 4-*A* (*lower right*). Schematic figure, lateral view of chest, demonstrating relative position of bullet in anterior mediastinum with planes of radiography.

nerves, and glands. In the usual x-ray exposure these anatomical parts are superimposed to a varying degree, depending upon the projection of the central beam. Because of this superimposition of shadows, roentgenologists have devised the terms "hilum," "root branch," "peribronchial markings" etc., to make up for planigraphic film has no more detail than the usual x-ray exposure and added thereto is the accumulated blurring of shadows above and below the desired plane. The examination is of value only provided it has certain advantages over the routine examination, which should consist of more accurate localization, better anatomical

differentiation, and a clearer demonstration of certain pathological entities.

Localization of an opaque foreign body within the mediastinum makes an interesting subject to prove the effectiveness of the planigraphic principles (Fig. 4-*A*). Three planigraphic sections of the thorax are shown: dorsoventral with the plane 6 cm. posterior to the anterior chest wall, showing the bullet in focus (Fig. 4-*B*);

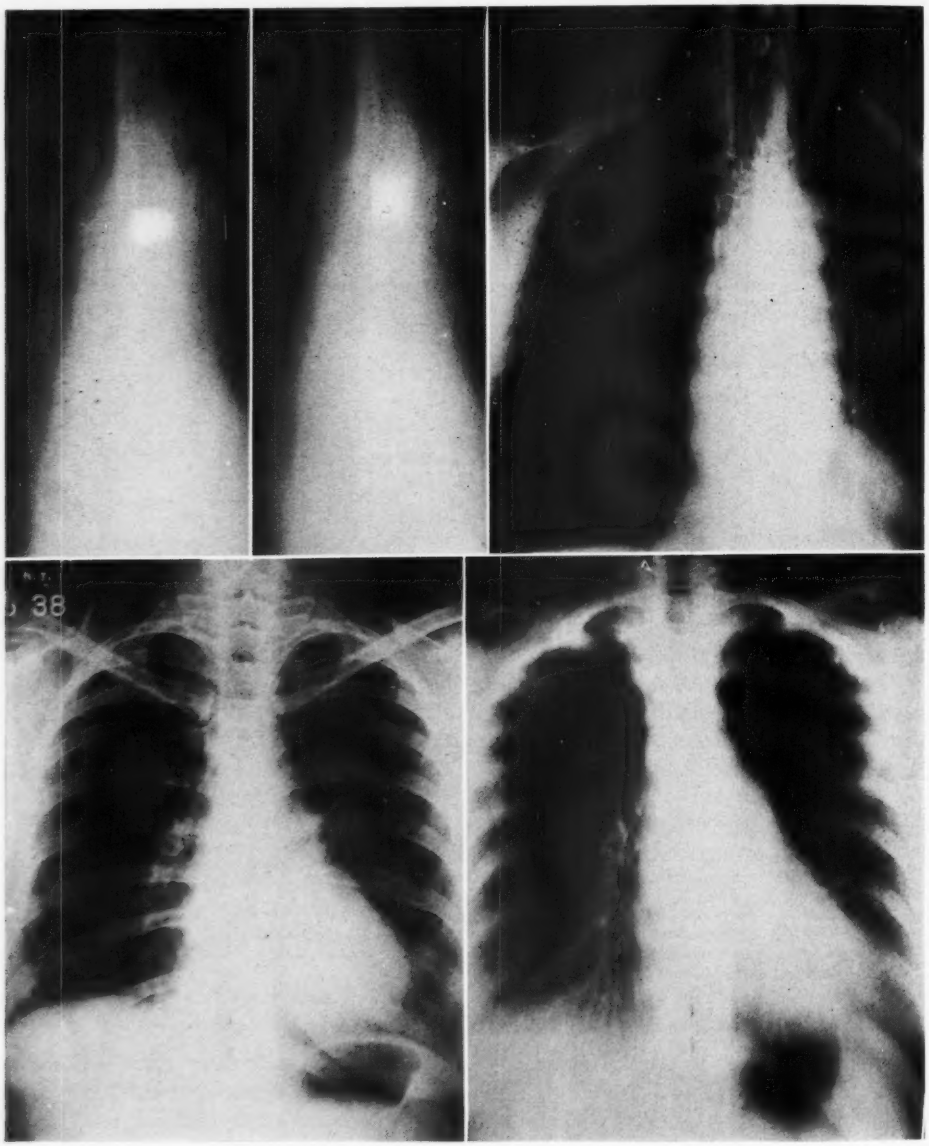


Fig. 4-*B* (*upper left*). Planigraph at 6 cm. level; bullet in focus.
Fig. 4-*C* (*upper center*). Planigraph at 8 cm. level, 2 cm. posterior to bullet.
Fig. 4-*D* (*upper right*). Planigraph at 15 cm. level, 9 cm. posterior to bullet.
Fig. 5-*A* (*lower left*). X-ray film.
Fig. 5-*B* (*lower right*). Planigraph at 9 cm. level. Two areas of consolidation in right upper periphery, each with central cavity.

dorsoventral with the plane 8 cm. posterior to the anterior chest wall, showing distortion of the bullet shadow from shifting the focal stratum posteriorly by 2 cm. (Fig. 4-*C*); ventrodorsal with the focal plane 15 cm. posterior to the anterior chest wall, showing complete obliteration of the bullet shadow in this plane, some 9 cm. posterior to that of the bullet (Fig. 4-*D*).

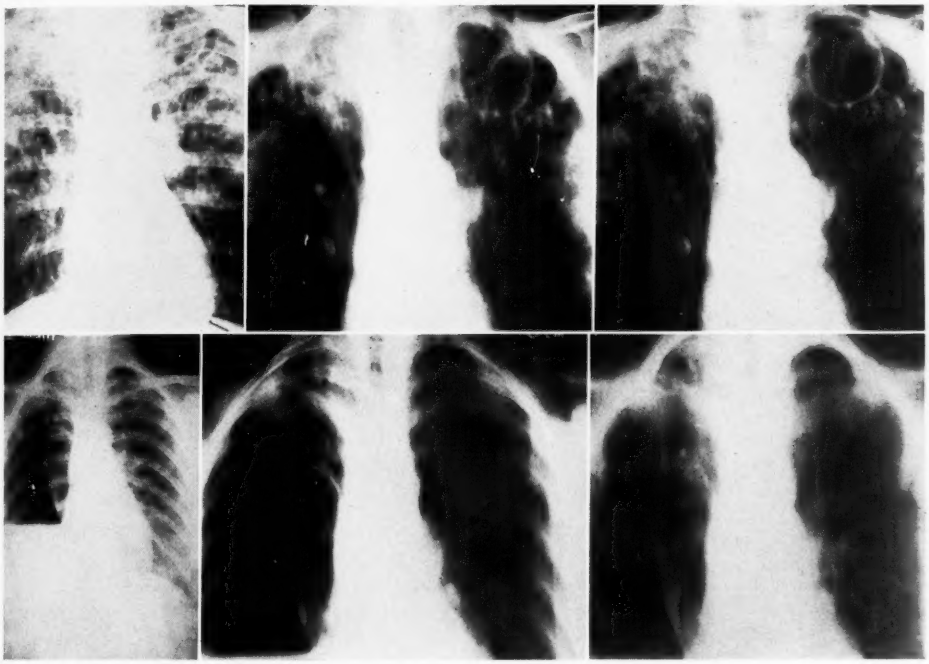


Fig. 6-*A* (*upper left*). X-ray film: advanced bilateral pulmonary tuberculosis.
Fig. 6-*B* (*upper center*). Planigraph at 11 cm. level: multiple cavities in left apex.
Fig. 6-*C* (*upper right*). Planigraph at 13 cm. level: large cavity, left apex, in focus.
Fig. 7-*A* (*lower left*). X-ray film: hydropneumothorax right.
Fig. 7-*B* (*lower center*). Planigraph at 8 cm. level. Note interlobar pleural thickening.
Fig. 7-*C* (*lower right*). Planigraph at 12 cm. level. Note cavity, right apex.

Tuberculosis.—Up to the present time the greatest usefulness of planigraphy has been developed in the field of pulmonary tuberculosis. Its treatment differs greatly if the process is made up of localized productive lesions, or has progressed into extensive fibrotic changes about a hidden cavity. Often most exacting roentgen examinations fail to disclose the true nature of a lesion, as illustrated by the following summary:

Mrs. F. R., aged 32 years, whose present illness dates back two years following hemoptysis. Repeated x-ray examinations in many institutions demonstrated no pulmonary pathology (Fig. 5-*A*). After a second episode of hemoptysis she was told that she had a lesion in her right lung, although this was not definite. Her right phrenic nerve was crushed in 1936. She then entered a tuberculosis sanatorium where she gained 20 pounds in weight under conservative treatment. Bronchoscopy demonstrated no bronchial ulceration as a cause of persistently positive sputum. In 1938, at a second tuberculosis sanatorium, a small productive lesion 2 cm. in diameter was finally discovered in the right second interspace. A planigraph at 9 cm. disclosed two tuberculous consolidations in the right upper periphery,

each with a small central cavity (Fig. 5-*B*).

When lesions are bilateral or there is extensive pathology overlying cavities (Fig. 6-*A*), sectional views tend to bring out the extent of the process and are often instrumental in demonstrating unsuspected areas of cavitation (Fig. 6-*B*). As a result, decision as to the choice of procedure to be carried out in any individual case, must often rest upon the findings of these sectional views (Fig. 6-*C*), namely, whether the

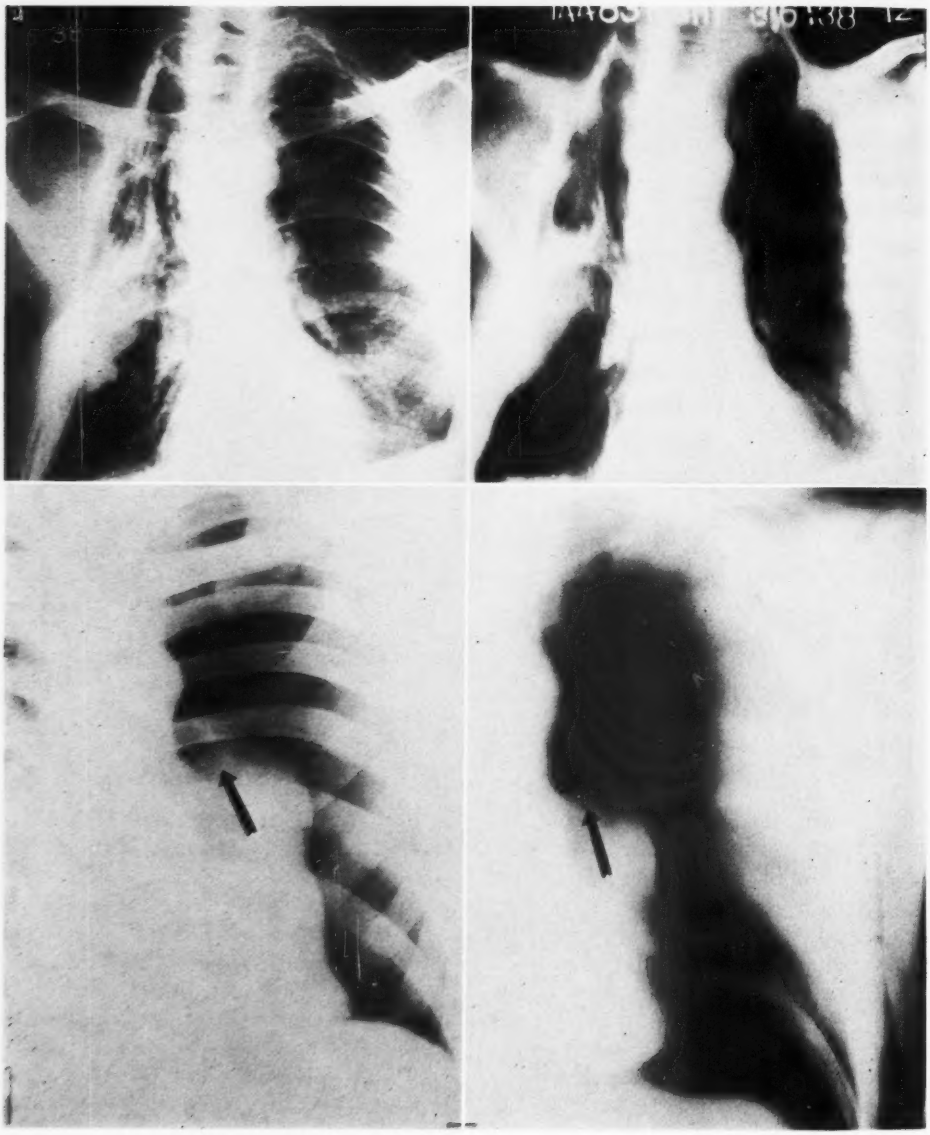


Fig. 8-A (upper left). X-ray film: thoracoplasty, right.
Fig. 8-B (upper right). Planigraph at 12 cm. level: residual cavity.
Fig. 9-A (lower left). X-ray film demonstrates adhesion from apex to mediastinum.
Fig. 9-B (lower right). Planigraph at 12 cm. level demonstrates level of the adhesion.

patient should be treated by bed rest, phrenectomy, collapse therapy, or thoracoplasty.

After pulmonary collapse, it is often necessary to determine whether all cavities have been compressed, and the following illustration, that of Miss J. I., aged 29 years, demonstrates high apical pleural adhesions preventing collapse of the apical zone (Fig. 7-*A*). Planigraphic studies visualized a residual cavity in this area (Figs. 7-*B* and 7-*C*).

After thoracoplasty, it is important to determine definitely whether or not the cavity has been compressed. The case of F. H., aged 31 years, who had a pneumolysis in 1935, followed by thoracoplasty in 1937, demonstrates this. An x-ray film showed what appeared to be compression of the cavity (Fig. 8-*A*), but planigraphy at the 12 cm. level (Fig. 8-*B*) definitely demonstrated a large residual cavity in the right upper lobe with a fluid level in its lower third.

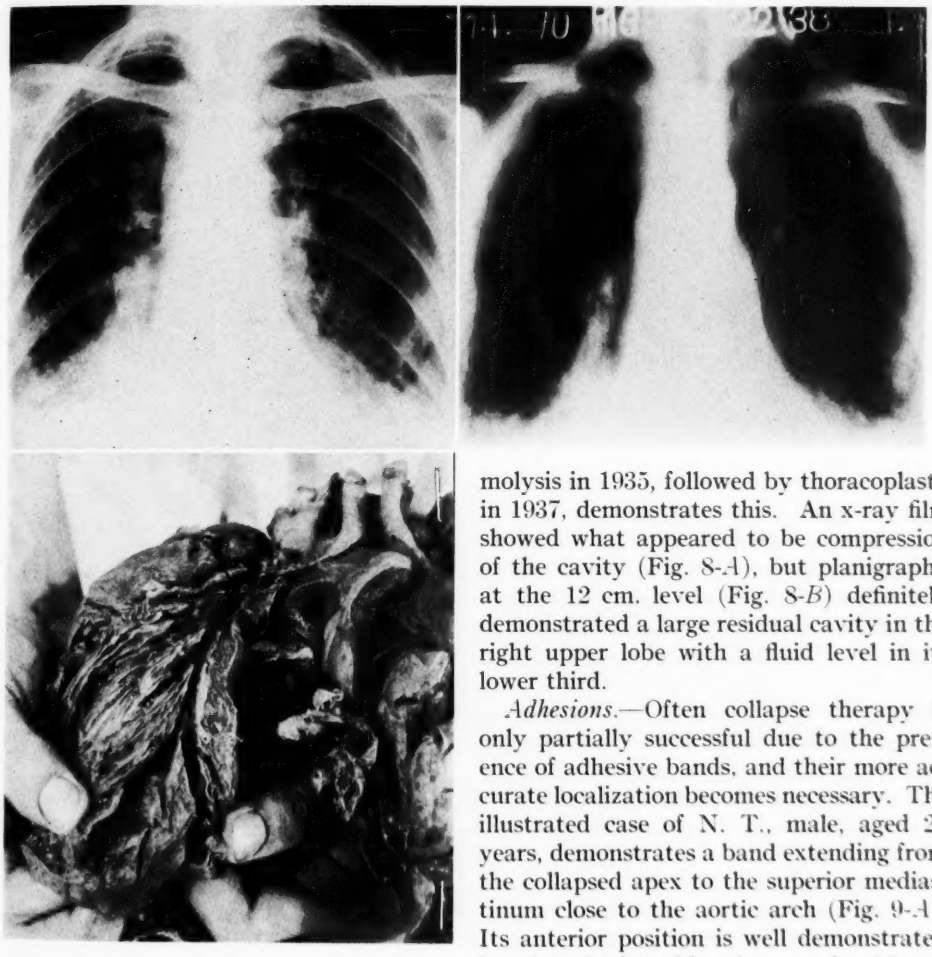
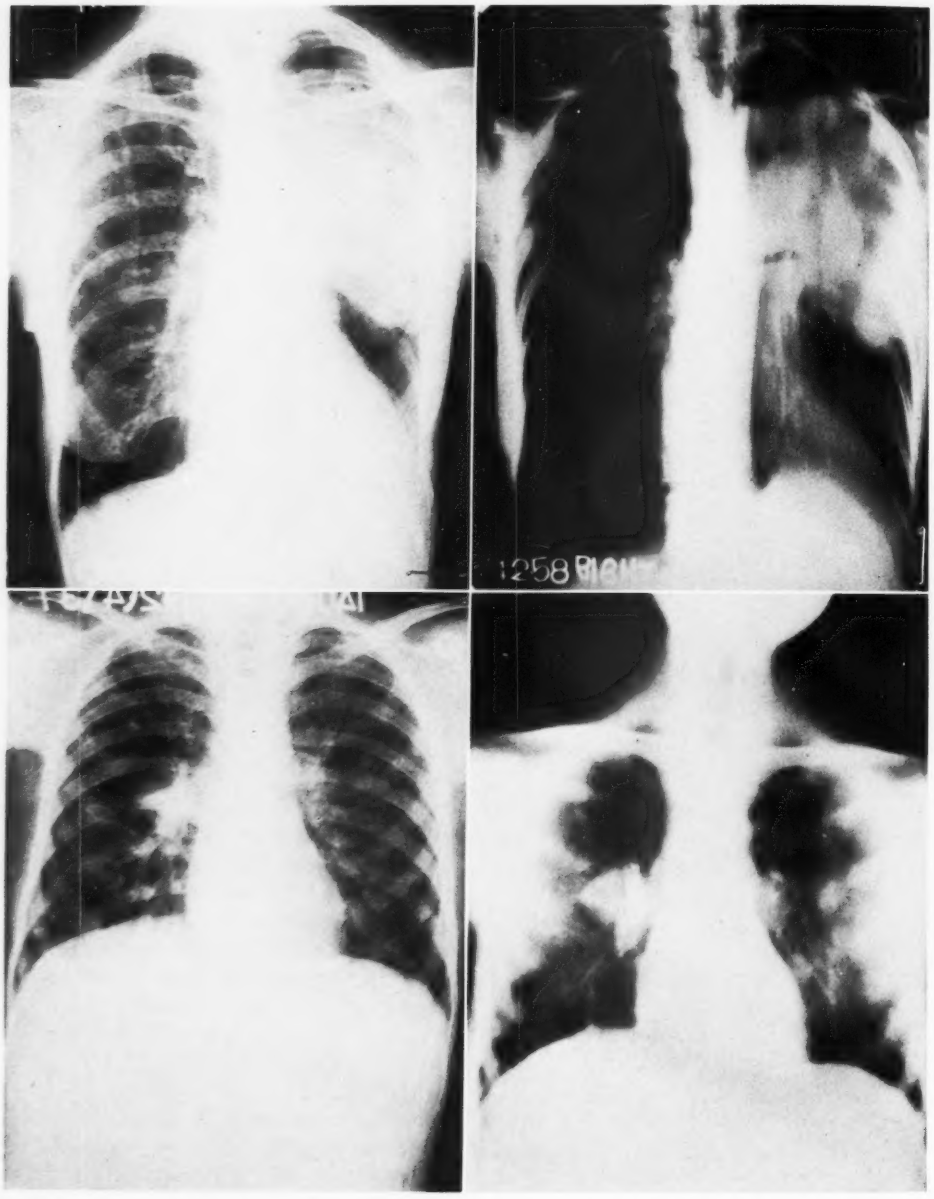


Fig. 10-*A* (*upper left*). X-ray film: leukemia; extensive bronchopneumonic consolidations, both bases.
Fig. 10-*B* (*upper right*). Planigraph at 12 cm. level, demonstrating elongated cavities, both bases.
Fig. 10-*C* (*lower left*). Photograph of lung, demonstrating extensive bronchiectatic dilatations of all lower bronchi.

Adhesions.—Often collapse therapy is only partially successful due to the presence of adhesive bands, and their more accurate localization becomes necessary. The illustrated case of N. T., male, aged 23 years, demonstrates a band extending from the collapsed apex to the superior mediastinum close to the aortic arch (Fig. 9-*A*). Its anterior position is well demonstrated by the planigraphic view at the 12 cm. level (Fig. 9-*B*).

Bronchiectasis.—It is often difficult to visualize bronchiectasis on an x-ray film without the aid of lipiodol (Fig. 10-*A*). The following illustration is of a case of lymphatic leukemia complicated by an extensive bronchiectasis. Planigraphy at the 12 cm. level clearly demonstrates elongated cavities with slightly scalloped edges in

the course of both the right and left lower bronchi (Fig. 10-*B*). Autopsy disclosed tremendous bronchiectatic dilatation of all of the lower main bronchi, which were partially filled with a thick muco-purulent exudate (Fig. 10-*C*).

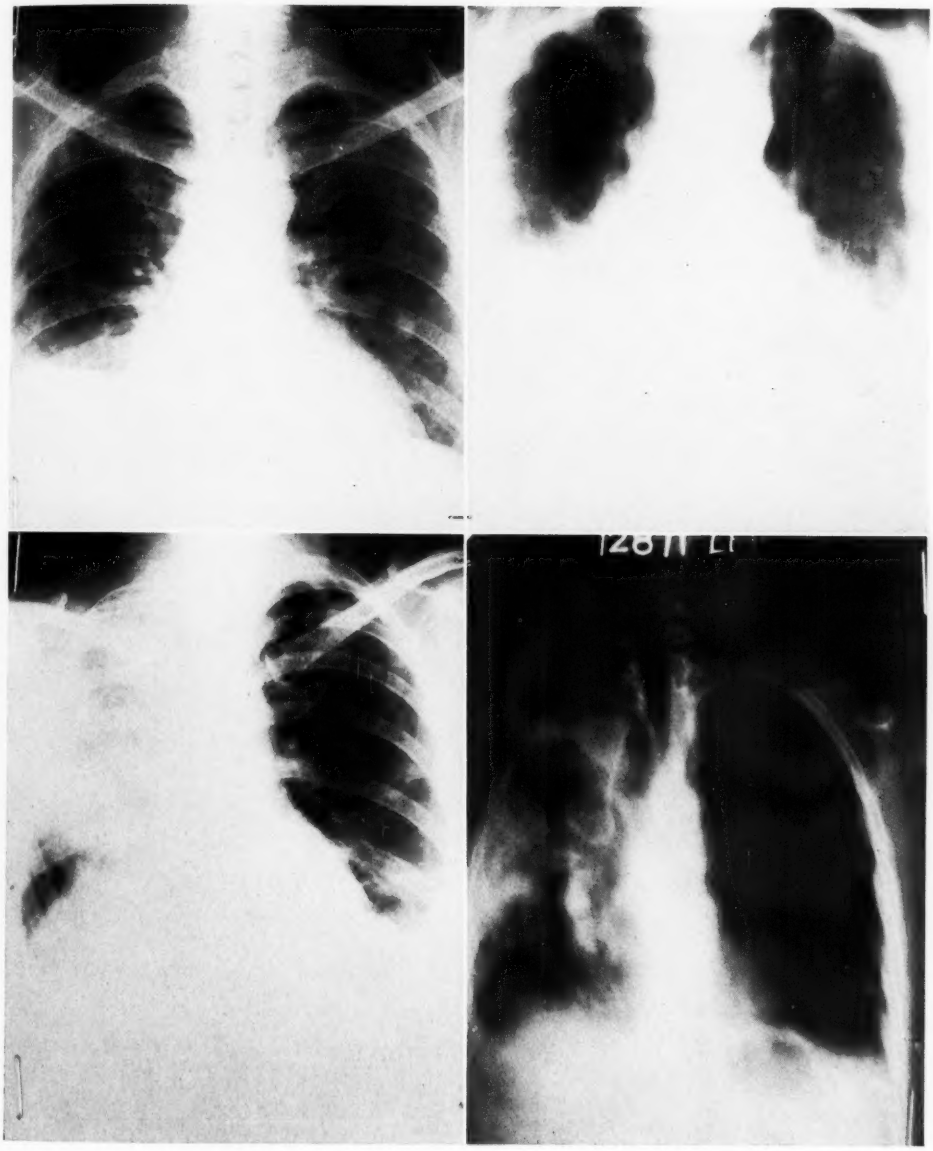


A *B*

Fig. 11-*A* (*upper left*). X-ray film: large pulmonary tumor.
Fig. 11-*B* (*upper right*). Planigraph at 8 cm. level, demonstrating occlusion of entering bronchus.
Fig. 12. Metastatic malignancy, Wilms' tumor. (*A*) X-ray film: large hilar masses, also metastases, right costophrenic angle. (*B*) Planigraph at 12 cm. level. Note appearance of hilar glands and metastases.

Tumors.—Planigraphy not only aids in more accurate localization of tumors, but has helped in determining the rate of growth or diminution in size at given levels. One case of a large pulmonary tumor (Fig. 11-*A*) is included to demonstrate the abrupt interruption in the course of the entering bronchus (Fig. 11-*B*).

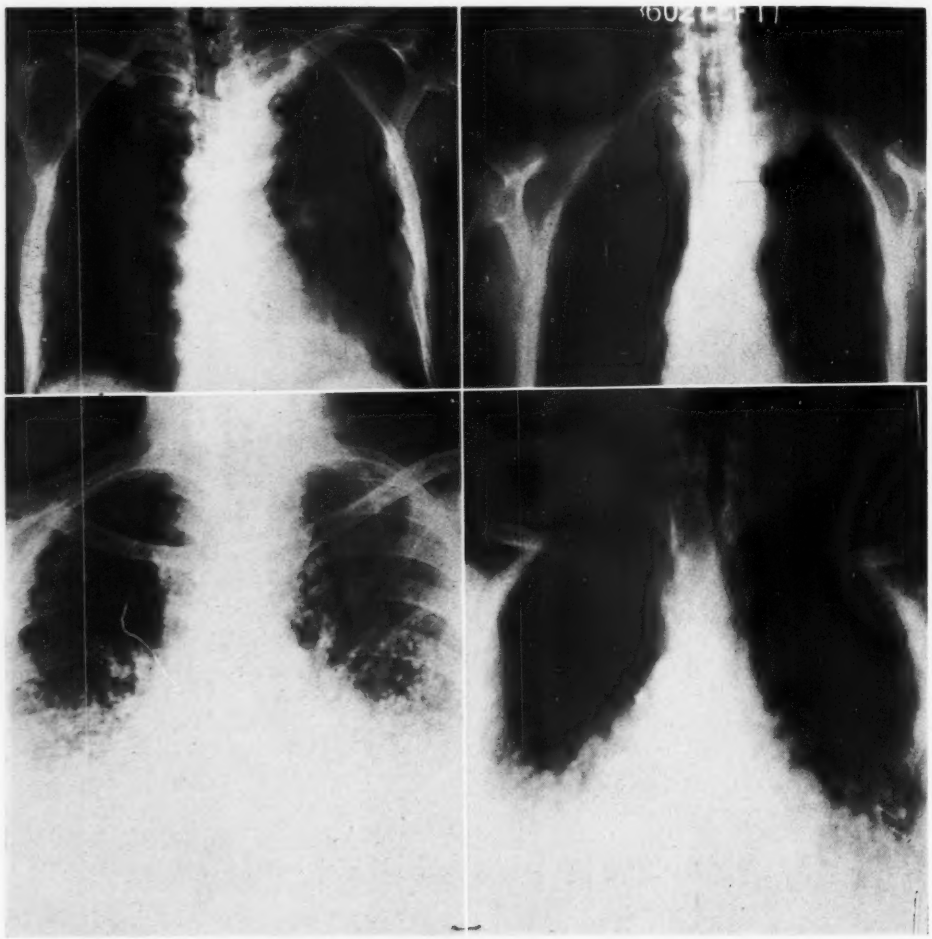
Metastatic Malignancy.—Sectional views not only bring out metastatic lesions not



A *B*

Fig. 13 (*upper*). Sarcoma primary in right popliteal space. (*A*) X-ray film, demonstrating metastases in lung-fields. (*B*) Planigraph at 10 cm. level, demonstrating lung metastases.
Fig. 14 (*lower*). Carcinoma of the breast, post-radiation. (*A*) X-ray film: pleural pulmonitis, right. (*B*) Planigraph at 12 cm. level, demonstrating distortion of tracheo-bronchial tree.

previously seen on routine films, but also make it possible to reconstruct the pulmonary lesions at given levels and study their response to radiation. Such lesions are illustrated by two cases.



A *B*

Fig. 15 (*upper*). Superior sulcus tumor, left. (*A*) X-ray film, Bucky diaphragm. (*B*) Planigraph at 10 cm. level.

Fig. 16 (*lower*). Carcinoma of thyroid. (*A*) X-ray film, demonstrating miliary metastases in both lower lung-fields. (*B*) Planigraph at 15 cm. level. Note distortion and narrowing of intrathoracic trachea.

First, that of a nine-year-old girl, H. S., who was suffering from a large primary abdominal tumor felt to be a Wilms' tumor of the kidney. The plain film (Fig. 12-*A*), post-radiation therapy, demonstrates the residual pulmonary metastases, seen best at the right base, with extensive perihilar glandular masses. The planigraphic section shows more definitely the infiltration at the right costophrenic angle and brings out clearly the solid tumor-like character of the hilar masses (Fig. 12-*B*).

The second case, W. E., male, aged 40 years, had a large soft tissue tumor mass removed from the right popliteal space in

1937, diagnosed as a sarcoma (synovioma). The x-ray film (Fig. 13-*A*) demonstrates metastatic masses in the lower left lung-field. Planigraph at the 10-cm. level shows a group of three rounded metastases in the left upper thorax which were not visualized on the original film (Fig. 13-*B*). Their relatively symmetrical spacing between the vascular channels is clearly shown.

Pleural Pulmonitis.—Following x-ray

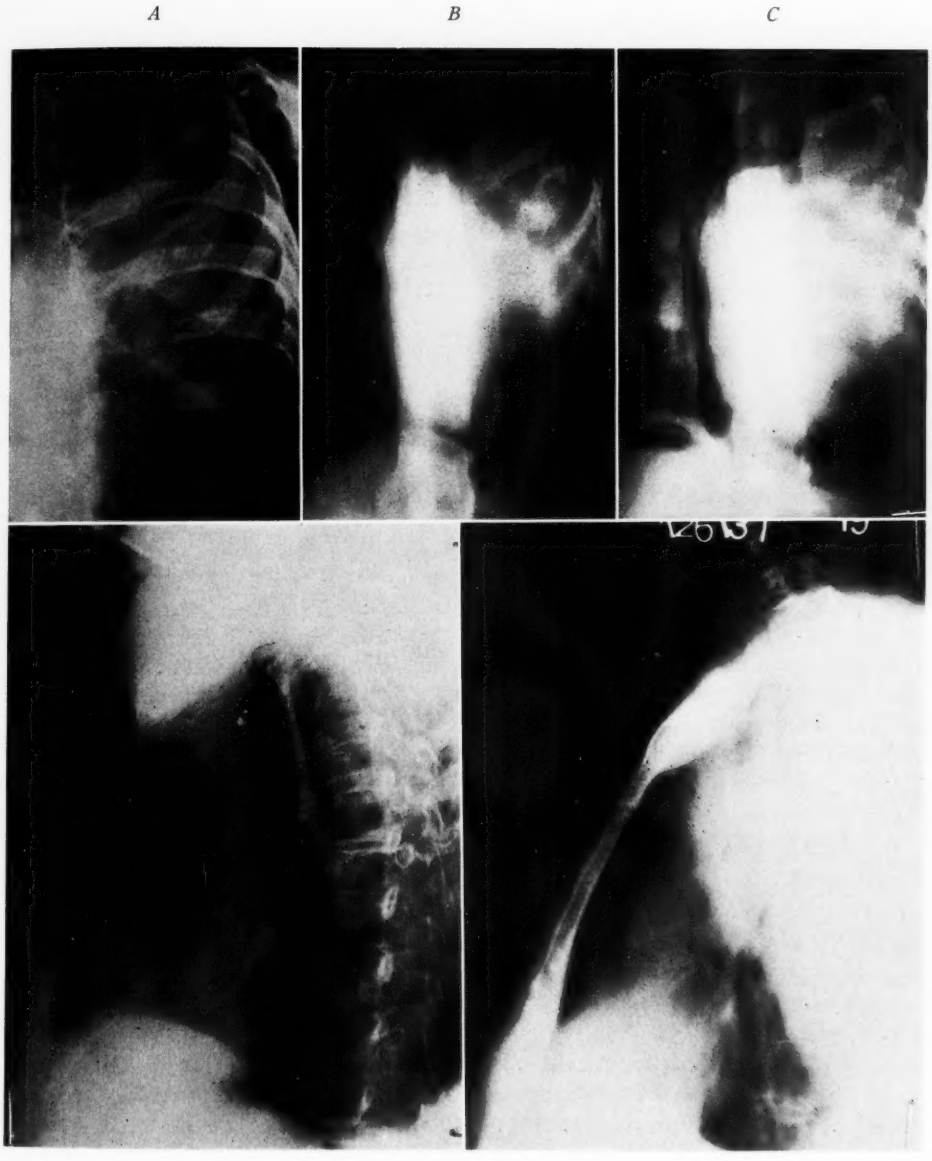


Fig. 17 (*upper*). Rib tumor. (*A*) Bucky diaphragm film. (*B*) Planigraph at 6 cm., near level of rib. (*C*) Planigraph at 12 cm. Note pneumothorax following needling of tumor.

Fig. 18 (*lower*). Carcinoma of breast, metastasis to sternum. (*A*) X-ray film, lateral. (*B*) Planigraph at 19 cm. level.

therapy to the chest and the development of pleural pulmonitis, the amount of fibrosis, atelectasis, and pleural thickening may result in such density that detail by ordinary methods becomes impossible. This is best illustrated in the case of Mrs. I. M., aged 46 years, who received extensive pre- and post-operative radiation therapy for carcinoma of the right breast (Fig. 14-*A*). The planigraphic view at the 12-cm. level clearly outlines the tracheobronchial tree (Fig. 14-*B*).

Superior Sulcus Tumor.—A case of left superior sulcus tumor is included. The patient was A. K., aged 81 years, whose chief complaint was severe pain extending down the left arm. The mass, though sharply demarcated, was so obscure on the ordinary film (Fig. 15-*A*), that it was entirely overlooked on a previous routine x-ray examination. Planigraph clearly demonstrates the tumor and its relationship to the lung apex (Fig. 15-*B*).

Superior Mediastinal Tumor.—One case of superior mediastinal tumor is shown—a proven carcinoma of the thyroid (Fig. 16-*A*). The patient was Mrs. L. F., aged 53 years. The planigraph demonstrates most clearly the encroachment of the tumor mass upon the intrathoracic trachea, and the miliary metastases in both lower lung-fields (Fig. 16-*B*).

Rib Tumor.—The rib tumor (case of E. B., aged 16 years), is certainly shown in greater detail on the Bucky film (Fig. 17-*A*). On the other hand, the large pendulous mass and its relation to the other thoracic structures is better demonstrated on the planigraphic films (Figs. 17-*B* and 17-*C*). The pneumothorax about this tumor was produced in an attempt to needle biopsy the mass.

Sternal Pathology.—Metastatic involvement of the manubrium is always difficult to interpret on the flat film (Fig. 18-*A*). A lateral planigraph, taken near the mid-line, shows how the mass involves the sternum in its upper internal aspect (Fig. 18-*B*).

SUMMARY

The history, definition, and technic of planigraphy are summarized.

The application and indications for planigraphy in the roentgen study of the thorax are discussed.

Planigraphic principles are demonstrated by the localization of a foreign body in the anterior mediastinum.

Indication for sectional x-ray studies of the thorax are discussed in conjunction with tuberculosis, pleural adhesions, bronchiectasis, lung tumor (primary), metastatic lung tumor, pleural pulmonitis, superior sulcus tumor, superior mediastinal tumor, rib tumor, and sternal pathology.

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MYOSARCOMA OF THE STOMACH

REPORT OF TWO CASES

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THE diagnosis of a gastric malignancy of the carcinomatous type is made with fair ease and accuracy, with the facilities and methods of procedure now at hand in the examination of the stomach. This statement, however, cannot be made regarding the sarcomatous gastric lesion. The explanation for this fact is, no doubt, due to the infrequent occurrence of gastric sarcoma and the various types of involvement of the stomach wall, as well as the distribution of the lesion in the stomach.

The literature of sarcoma of the stomach begins with a case report by Bruch (2) in 1847, followed, in 1862, by a report of two cases of myosarcoma of the stomach by Virchow (12). John Douglas (4), in a study of the literature, found 230 cases up to 1920. In a more complete report, D'Aunoy and Zoeller (3) found 335 cases up to and including 1929. From 1929 to 1936, Glenn and Douglas (7) found 36 additional cases reported, bringing the total to 371. From 1936 to the present, 12 additional cases appear in the literature, bringing the grand total to 385, including the two cases reported herein.

Ewing (6) states that sarcoma of the stomach constitutes about 1 per cent of the gastric malignancies. Masson (10), at the Mayo Clinic, reports 13 cases in 2,067 gastric malignancies. Pack and McNeer (11) report five cases of sarcoma of the stomach in 400 malignant gastric lesions. These figures agree fairly well with Ewing's statement.

Various estimates of the frequency of myosarcoma have been made. Lubarsch (9) believes 16 per cent of all sarcomatous lesions of the stomach are myosarcoma. D'Aunoy and Zoeller (3), in their report of 335 cases of gastric sarcoma, in which a complete histologic study was made of 100, classified 8 per cent as myosarcoma. Balfour and McCann (1), in a report of 54 cases, found 6.7 per cent myosarcoma. That the correct percentage is near an average of these figures is indicated by a comparison of the total number of reported cases of sarcoma of the stomach with the number of myosarcomas reported, which gives the incidence of myosarcoma to be 11.4 per cent. Hence, it would appear that approximately one in a thousand malignant lesions of the stomach is a myosarcoma.

Edwards and Wright (5), in a review of the literature, found 38 cases of myosarcoma reported up to 1933. Since that time, a review shows four additional cases have been reported, so that, including the two cases reported herein, it would appear that a total of 44 cases are on record.

The myosarcomatous lesions of the stomach are frequently similar histologically to the spindle-cell sarcoma, the neurosarcoma and the fibrosarcoma. Frequently, two types of cells are represented in one lesion. The muscle cells may contain a considerable amount of hyaline and thus simulate the cells of a fibrosarcoma. Ewing (6) explains that it is not unusual to find cells of neural origin in a myosarcoma, as was true in Case 2 herein. Myosarcoma has been found in all portions of the stomach; on the greater curvature as well as on the lesser, at the pylorus and pars media but rarely in the cardia. In its relation to the stomach wall, it may be endogastric (submucosal), intramural, or exogastric (subserosal). The tumor itself may be pedunculated or sessile.

Ulceration or central degeneration of the tumor may lead to hemorrhage in the endogastric or submucosal type of lesion.

A study of the gross pathology convinces one that a typical roentgenologic appearance should not be expected. That it will be difficult and at times impossible to differentiate the lesion from a carcinoma is also true, though, as Kessler (8) points

out, smoothness of contour of the tumor should suggest sarcoma and he advises that sarcoma should be considered when a tumor is found on the greater curvature, particularly if the typical saucer-shape deformity of carcinoma at this site is lacking.

The endogastric, pedunculated or sessile, tumor generally has a round form, the borders of which may be smooth or ulcerated. The adjoining walls are not infiltrated and there is a relative mobility of the tumor in regard to the gastric wall. If the tumor is pedunculated, there may be a persistent notch corresponding to the implantation of the pedicle. There is, as a rule, little or no interference with peristalsis. The sessile type of tumor on the greater curvature stomach wall is usually convex in contrast to the crescentic deformity of carcinoma of the stomach.

The exogastric, sessile or pedunculated, sarcoma of the stomach produces a smooth, regular, extrinsic filling defect of the stomach or a compression of the neighboring abdominal organs. A cone of contraction at the site of the pedicle may be found, and, when the tumor is manipulated, the effect on the gastric wall is demonstrated. Mucosal ulcerations are rare; central degeneration and necrosis of the tumor may lead to ulceration.

The intramural type of involvement of the stomach wall, which rarely occurs, is truly infiltrative and produces no deformity, not unlike a carcinomatous lesion.

The two case reports which follow are representative as to tumor type of the endogastric myosarcoma and an exogastric neuromyosarcoma. In the latter case there was calcification of the tumor mass which we believe, from our study of the literature, to be a singular finding.

Case 1. C. M. J., a patient of Dr. C. C. Nesselrode, white male, aged 28, had as chief complaints weakness, hematemesis, and nausea. The family history was negative. Of interest in the past history was the fact that eight months before the present illness, while the patient's stomach was empty, he ate persimmons and shortly thereafter drank water before eating any other food.

The onset of symptoms was seven months prior to his admission to the hospital, with increasing fatigue, pallor, and tarry stools. The patient was somewhat short of breath on exertion but had a good appetite and complained of no discomfort nor pain of any type. These symptoms gradually subsided. On Feb. 17, 1937, his employer sent the patient to his physician because of pallor, and his hemoglobin was found to be 25 per cent (Sahli). Hospitalization was advised. After hospitalization, symptoms of hematemesis, epigastric distress, marked general weakness, repeated vomiting, and abdominal tenderness appeared.

Physical examination revealed a pale, weak, dehydrated, white male, about 30 years of age, lying in bed in apparent comfort. The temperature was normal, pulse 90, and respiration 22. The lips and tongue were almost white and the scleræ were unusually pale. The pupils were regular, equal, and reacted to light. There was a marked oral sepsis. There were no heart murmurs; neither were there any râles nor areas of dullness over either lung-field. An area of tenderness and rigidity was present in the hypogastrium. No masses were palpable; no adenopathy nor abnormal reflexes were found.

Laboratory report: Hemoglobin (Hayden-Hauser), 25 per cent; red blood cells, 2,500,000; white blood cells, 6,900. Differential: Polymorphonuclear, 26 per cent; lymphocytes, 30 per cent; eosinophiles, 1 per cent. Wassermann, negative.

Roentgenograpic examination revealed the chest fluoroscopically negative. A rounded negative shadow, about the size of a small lemon, was seen in the dependent portion of the stomach. The mass producing the negative shadow was fairly hard to palpation, could be displaced with some difficulty, and gave the definite impression of an intraluminary filling defect (Fig. 1). The duodenal bulb showed no deformity and no definite ulceration of the stomach wall was seen. Because of the history of

the recent severe gastric hemorrhage and the poor condition of the patient, cautious palpation was practised.

Fig. 1. Roentgenogram of stomach (Case 1) showing intraluminary defect.

Correlating the clinical symptoms with the above roentgenographic findings, it was thought that the mass could be best explained as either a phytobezoar of the persimmon type or a neoplasm of the greater curvature of the gastric wall. Further examination was planned when the patient's condition would permit more satisfactory examination. However, the hematemesis continued and the patient's hemoglobin had been elevated only slightly by three blood transfusions in seven days. Therefore, it was deemed inadvisable to postpone laparotomy.

At operation, under local anesthesia, a puckered scar on the anterior surface of the stomach near the greater curvature and about three inches proximal to the pyloric ring was found, which was the base of the palpable, movable, intraluminary mass (Fig. 2). No adenopathy in the surrounding tissue nor masses in the liver were apparent. The tumor was removed by a V-shaped resection and the abdomen was closed without drainage.

The pathologist reported an oval-shaped

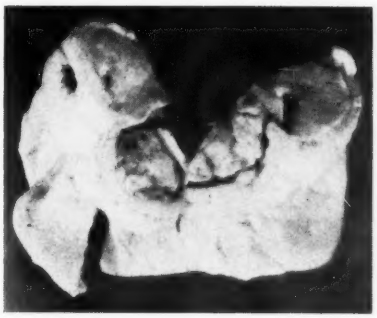

Fig. 2. Photograph of tumor (Case 1) showing the two areas of ulceration.

submucosal tumor which measured 4.5 by 3.5 cm. There were two medium-sized areas of ulceration of the mucosa covering the tumor (Fig. 3). A histologic diagnosis of myosarcoma was made.

The patient's post-operative recovery was uneventful with the exception of a thrombophlebitis on the sixth post-operative day. He was dismissed on the thirteenth post-operative day. For a period of 17 months he has gained weight, worked daily, and has had no gastric disturbance of any type.

Case 2. Q. P. B., a patient of Dr. J. F. Hassig, aged 69, white male, had complaints of weakness, pallor, and vomiting of blood. The family history was essentially negative. Of note in the past history was the fact that for several years the patient had noted a progressive anemia, pallor, increasing fatigue, some nervousness, but no pain nor discomfort. About two weeks after the initial symptoms he consulted his family physician who noted the pallor but found no other abnormal physical findings. The hemoglobin determination was 45 per cent and the red blood cells, 2,600,000.

Two days following the above examination, on May 17, 1936, while eating noonday lunch, the patient fainted, following which he vomited several times and each

time the vomitus contained a large amount of blood. The total quantity of blood lost was estimated at about 1000 c.c. The patient grew weaker and was definitely dyspneic, cold and clammy, and dizzy, and was removed to the hospital.

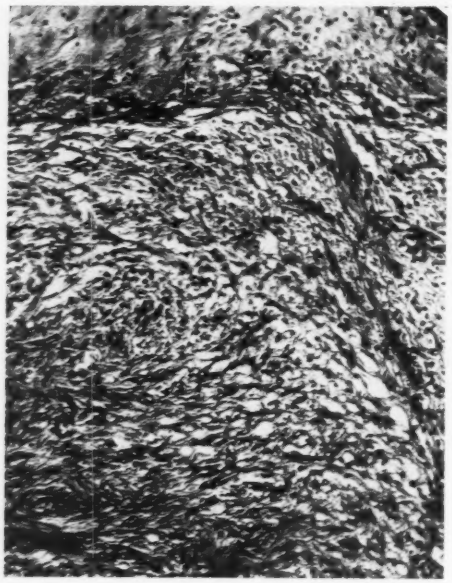

Fig. 3. Photomicrograph of tumor (Case 1). Diagnosis, myosarcoma.

After hospitalization, physical examination revealed a white male, aged 69, good nutrition, extremely pale, obviously in shock but complaining of no definite pain or discomfort. The eyes reacted to light and accommodation, the heart and lungs were essentially negative to examination, and the blood pressure was 110/60. The abdomen showed a good muscular tone but no masses were palpated; neither was there any evidence of tenderness or rigidity. The liver was not palpable and there were no abnormal reflexes nor adenopathy of any type. The laboratory report: Hemoglobin, 27 per cent; red blood cells, 2,150,000; white blood cells, 9,500. Wassermann, negative; urine essentially negative. Gastric analysis showed the total gastric acidity to be 56° and the free hydrochloric acid 43°.

Roentgenological examination, on June 8, 1936, showed the chest fluoroscopically negative. Stasis in the lower esophagus was demonstrated, the media rising and falling with respiration. Canalization of the stomach was tardy. An irregularity of the pyloric antrum was demonstrated, presenting what appeared to be a diffuse gastrospasm with a bud-like extension of the media posterior to the pyloric antrum. The findings were confusing.

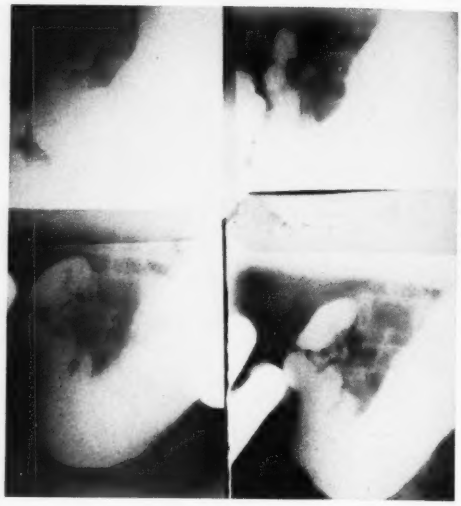

Fig. 4. Roentgenograms of stomach (Case 2) showing inconsistent radiographic appearance of the prepyloric area.

The patient was re-examined on the following day; the contracted pyloric antrum was visualized but an ulcer crater was not demonstrated. Peristalsis over the pyloric antrum was interrupted and confusing in detail. The deformity varied in its appearance from that seen previously, the bud-like shadow presenting a different relationship.

One week later, the stomach was again examined. In the interval, belladonna to subphysiological effect had been administered. At this time, there was a 25 per cent residue in the stomach while previously

there had been no six-hour remainder. There was an easily palpable, rounded tumor which moved with respiration and moderately dilated, and there was moderate thickening of the walls of the stomach. A tumor mass about the size of a

Fig. 5.

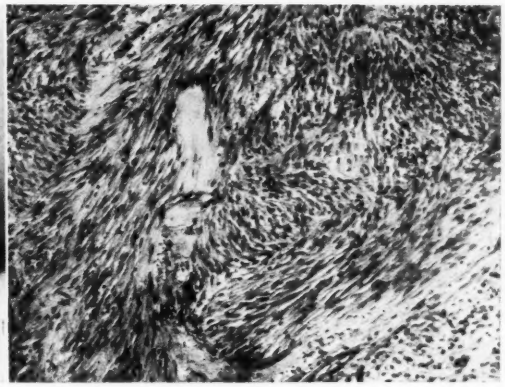

Fig. 6.

Fig. 5. Photograph of tumor (Case 2); metric rule indicates size.
Fig. 6. Photomicrograph of tumor (Case 2). Diagnosis, neuromyosarcoma.

gave the impression of being located behind the pyloric antrum. This mass was difficult to feel when the stomach was filled. It appeared to be definitely more anterior than the kidney and offered the impression of originating outside the stomach. The mass appeared too low to have its origin in the gall bladder. Repeated roentgenograms showed the pyloric end of the stomach inconsistently irregular with the shadow of the incomplete duodenal bulb superimposed on the irregularity (Fig. 4). Roentgenologically, the following were considered the most probable: (1) Carcinoma of the pancreas with secondary involvement of the posterior gastric wall; (2) peptic ulcer with bizarre infiltration, and (3) carcinomatous infiltration secondary to gastric polyposis.

The patient remained at the hospital for a period of about a month, during which time he received a number of blood transfusions and regained considerable strength. He had no symptoms referable to his stomach, had a good appetite, and felt fairly well.

On June 18, 1936, an exploratory laparotomy was done, the stomach was found large orange, attached by a narrow base to the anterior wall of the stomach just proximal to the pylorus, was found (Fig. 5). The point of attachment of the tumor encroached upon the pylorus. It varied in color and had a bosselated appearance. No definite metastasis nor enlargement of the lymph nodes was found. The tumor was resected in the long axis of the stomach, the resection including a portion of the pyloric ring. The stomach and abdomen were closed, including two properly placed drains.

The tumor weighed 124 grams and measured $8 \times 6 \times 4.8$ cm. The tissue was well encapsulated by a smooth glistening membrane. The end of the tumor attached to the stomach wall showed the mucosa thinned and in the central portion was an ulceration that led into a sinus tract in the central portion of the tumor (Fig. 6). The histologic diagnosis was an infected neuromyosarcoma of the stomach, showing considerable hyaline degeneration and calcification. The calcification of the tumor explained the changing roentgenographic picture and confusion, when interpreted, as due to opaque media (Fig. 7). (As an

afterthought, a preliminary scout film would have been helpful.)

The post-operative course was rather stormy, with some abdominal distention, fever, pain, etc., but the patient recovered and left the hospital in comparatively good health one month after the operation.

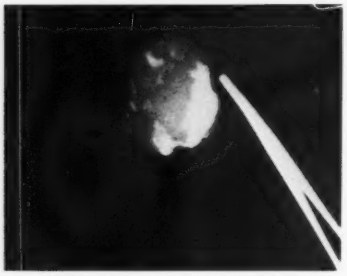

Fig. 7. Roentgenogram of tumor (Case 2) showing calcification.

About three months later, the patient returned to the hospital, at which time he had a rather marked secondary anemia and a definite localized empyema of the right lung. This was treated by aspiration and the patient recovered without further complications.

At the present time, approximately two years after operation, the patient is in excellent physical condition, has gained considerable weight, has no abdominal symptoms, works daily, and shows no evidence of recurrence.

SUMMARY

1. A study of the literature shows that 385 cases of sarcoma of the stomach have been reported. Of these, 44 cases were myosarcoma.

2. The characteristic roentgenologic features of myosarcoma are discussed.

3. Two case reports of gastric myosarcoma are given, Case 1 being an example of the endogastric type of lesion and Case 2 an example of the exogastric type.

4. In Case 2 the tumor showed calcification, which appears to be singular in its occurrence.

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THE JOINT CHANGES IN HEMOPHILIA[1]

By NATHAN B. NEWCOMER, M.D., *Denver, Colorado*

THE fact that characteristic joint changes occur in hemophilia is not generally recognized by the medical profession, including roentgenologists, orthopedists, and surgeons. Quite often these joints are diagnosed as tuberculous or arthritic, and may even go to operation before it is discovered that the patient is a hemophiliac. Even when the patient is known to have hemophilia, the physician may not realize that the joint condition is due to hemorrhages into the joint, but may think it is due to some infection and advise removal of the teeth, tonsils, etc. The fact that we do not see similar cases often is probably the reason such errors are made; however, we must be on the lookout, since failure to diagnose such a case may be fatal to the patient. Key (7), who has written an excellent article on the pathology in hemophilic joints, makes the following statement:

"Consequently, it does not occur to the average surgeon that he may some day open a hemophilic joint under an erroneous diagnosis. This, in spite of the facts that a hemophilic arthritis may closely resemble conditions for which operative intervention is indicated, and that the literature contains several reports of surgical tragedies which resulted from operations upon hemophilic joints under an erroneous diagnosis. Consequently, it is important that surgeons who operate upon joints should know thoroughly the clinical picture of hemophilic arthritis."

There are three recognized types of hereditary bleeding: (1) hemophilia, (2) hereditary hemorrhagic telangiectasia (Osler), and (3) hereditary hemorrhagic diathesis (Hess).

In hemophilia, L. J. Witts (14), *Guy's Hospital Reports*, says:

"The hemorrhagic tendency manifests itself in early life and the joints are often affected with hemarthrosis. The formed elements and the chemical constituents of the blood, and the walls of the blood vessels appear to be normal, but the clotting of the blood is much delayed, perhaps as a result of some alteration in the physical structure of the plasma. Hemophilia is inherited, by the law of Nasse, according to which it is transmitted only by females and manifested only by males. In Mendelian terminology it is a recessive sex-linked characteristic, and females should be affected in the proportion of 1 to 200 affected males.

"Over thirty years ago Osler separated off from hemophilia the condition of hereditary hemorrhagic telangiectasia. In this disease the hemorrhages come from small nævi in the skin, mucosæ, and the viscera, which are sometimes obvious but on occasion easily overlooked. The blood is normal. The disease affects males and females equally, being transmitted from generation to generation and behaving as a Mendelian dominant.

"In 1916, Hess distinguished a third hereditary hemorrhagic diathesis, a hereditary form of purpura hemorrhagica. In most of Hess's cases the blood platelets were diminished in numbers, and the diathesis presents just those symptoms which we are accustomed to associate with shortage of platelets, however acquired."

According to Davidson and McQuarrie (3):

". . . . the following factors are normal in hemophilia: blood calcium, fibrinogen, antithrombin, thrombokinase, serum proteins, number of blood platelets, blood hydrogen ion concentration, bleeding time, capillary resistance, and clot retractility and toughness."

Patek and Stetson (10), in 1936, state:

"There is a substance in normal blood which in small quantity effectively reduces the clotting time of hemophilic blood, ...

"In normal plasma rendered free from platelets, whether by filtration or centrifugation, there is a substance which is effective in reducing the clotting time of hemophilic blood. This substance also resides in the plasma of thrombopenic purpura. It is either unavailable or greatly diminished in hemophilic plasma.

"In the clotting of either hemophilic or of

[1] Presented before the Midsummer Radiological Conference, Denver, August, 1938.

normal plasma, hemophilic platelets behave similarly to normal platelets. Filtration prolongs the clotting time of both normal and of hemophilic plasmas, on recalcification. This is due, presumably, to the removal of platelets. However, the addition of filtered normal plasma to whole hemophilic plasma causes a sharp reduction of clotting time on recalcification. This indicates that the clot-promoting substance provided by normal blood resides in the platelet-free plasma. Moreover, the addition of a suspension of normal platelets of the concentration present in normal plasma to whole hemophilic blood causes no change in the latter's clotting time."

Hess (6) says that, "Typical hereditary hemophilia is not associated with a deficiency of calcium."

Others claim that the active principle causing coagulation is in the blood platelets, and because of their lack of fragility, it is not liberated into the plasma.

C. L. Birch (1) states:

"Blood platelets of hemophiliacs have a greatly increased resistance both to hypo- and hypertonic salt solution. When the resistance of hemophiliac platelets is overcome mechanically the blood coagulates in normal time."

Apparently a complete solution of the problems entering into hemophilic blood has not been reached.

Konig's classification of hemophilic joints is generally followed. Quoting from Solis-Cohen and Levine (12):

"Konig divides the pathologic changes occurring in the joint into three successive phases: (1) hemarthrosis; (2) panarthritis; (3) the regressive stage.

"(1) Hemarthrosis is associated with thickening of the fibrous joint capsule and is unaccompanied by bone changes.

"(2) In the panarthritic stage definite vacuolization in the epiphysis above the articulating surface occurs, the edges of the latter being sharply etched and well defined. The opposing joint surfaces are separated by a hemorrhagic effusion.

"(3) In the regressive phase the loss by destruction or absorption of cartilage is due to interference with the circulation and results in deformity. Pseudo-lipping is present, suggesting a true osteo-arthritis. True bony osteophytes develop only after the destruction of joint cartilage. Limitation of motion of the affected joint is often associated with regional muscular atrophy."

Doub and Davidson (4) describe the joint changes as follows:

"From the brief review of the roentgen-ray findings, as noted in these seven cases, and in the review of the rather scanty literature on the subject, it would seem that two groups of roentgen-ray signs must be considered, *viz.*, (1) the signs seen in the early cases, or in those exhibiting no destructive change, (2) the signs seen in the advanced cases which exhibit destructive changes.

"In the first group the findings include: (1) Effusion of blood into the joint; this may or may not show calcification. (2) Thickening of the joint capsule. (3) Lipping, similar to hypertrophic arthritis. These changes may or may not be diagnostic, but the presence of a calcified hematoma in a case presenting joint symptoms is strongly suggestive of this condition. In these cases, there is no bone destruction and no cartilaginous involvement. This type of case may suffer repeated attacks of hemarthrosis without the signs progressing beyond this point.

"The findings in the second group are much more distinctive. (1) General or localized cartilaginous destruction. (2) Bone destruction of several varieties, (*a*) punched-out areas in the epiphysis, with an intact articular surface due to hemorrhage into the epiphysis; (*b*) destruction of the articular surface, often with localized rounded areas of destruction extending into the epiphysis. (3) Blood clot in the synovial cavity which may become organized, with some calcification. The above signs are characteristic of hemophilic arthritis and when the typical punched-out areas of destruction are seen in conjunction with the organized blood clot the diagnosis can be made without other clinical data."

Rypins (11) states:

". . . . that widening and deepening of the intercondylar fossa, with or without arthritic changes in the knee joint, in a member of the male sex is characteristic of hemophilia."

Joints Most Commonly Involved.—The most comprehensive list I have seen is that of H. B. Thomas (13), who reports as follows:

"From 1930 to 1935, 98 cases of hemophilia were studied at the Research and Educational Hospital and the Illinois Surgical Institute for Children.

"At the time of the first examination, the ages of the patients ranged from birth to 65 years. Seventy-seven patients (78.5 per cent) gave a history of joint involvement, while 60 (61.2 per cent) had permanent joint deformity.

The percentage of joint involvement is actually much higher than these figures would indicate because in the average case it is a rather late manifestation, and many of these patients are young children who undoubtedly will later develop joint hemorrhage. Of the 65 patients ten years of age and over, 52 (80 per cent) gave a history of joint involvement. Of the joints involved, the knee was by far the most commonly affected (68 per cent). Next in order of frequency were the ankle (56 per cent), the elbow (53 per cent), the hip (16 per cent), and then, more rarely, the small joints—the fingers (15 per cent), the wrist (5 per cent), and the toes (2 per cent). The shoulder seemed to have escaped permanent deformity more than any other joint. The spine was involved in three cases."

Contractions of the arm and wrist, from hemorrhage into the muscles, have been reported. One of our cases had this condition in both the forearm and wrist. Hemorrhages into the hip are reported as very uncommon; however, Thomas reports them in 16 per cent of the cases. Two of our three cases had hemorrhages into the hip. Both were adults, but no changes are shown in the films. When such hemorrhages occur before maturity, they produce changes resembling Perthes' disease.

Regarding involvement of the hip joint, Professor Löhr (8) states:

"A review of the world's literature of definite cases revealed the surprising result that all cases before puberty, with acute heavy hip-joint hemorrhages, showed the roentgenologic picture of a florid Perthes' disease. This condition has been attributed by us to the high sensitivity of the youthful epiphyseal bones to the physical and chemical influences exerted by the hemorrhages.

"On the other hand, the x-ray pictures of the hip joints of adult hemophiliacs show the most diverse changes: now a healed Perthes' condition following hemorrhages in youth, coxa valga formation, bone cyst-like formations in the head and neck of the femur, or in the trochanter, together with a more or less definite arthritis deformans. Hemorrhages into the head of the femur after puberty do not furnish the typical picture of a Perthes-Calvé hip disease."

Brailsford (2) states:

"If the hip joint is involved in young persons, the epiphysis of the femoral head shows somewhat the same fragmentation seen in Perthes' disease. Radiographs showing these changes are used to illustrate the papers of Löhr, Konig, and Peterson. The degenerative changes may result in a deformity or complete destruction of the femoral head.

"Montanari described a case, aged two, in which the femoral head was completely destroyed."

In spite of the fact that Thomas reports involvement of fingers 15 per cent, wrist 5 per cent, toes 2 per cent, very little damage is done to the small joints, or at least very few reports are made of extensive damage to them.

However, Firor and Woodhall (5) report an unusual case involving the thumb of a hemophiliac, "pseudo-tumor" with bone destruction, which had twice been diagnosed as a sarcoma.

Treatment.—The scope of this paper does not cover treatment in detail. Apparently, blood transfusions are most often used. Placental extract, amniotin, snake venom, vitamin C, foreign proteid shock, and many other substances are used. Firor and Woodhall advise electrocautery in all surgical operations on known hemophiliacs, and suggest that, "There is a favorable influence of cauterization of hemophilic tissue upon reduction of the clotting time."

John C. Otto (9), who gave one of the earliest descriptions (1803) of hemophilia, had a keen perception of the hereditary factor in hemophilia. His article is quoted by many subsequent authors, but I have never seen his method of treatment quoted, and do not know anything about its merits or whether or not it has been used since his day. However, his insistence on its efficiency makes it rather interesting. Otto says:

"A few years since, the sulphate of soda was accidentally found to be completely curative of the hemorrhages I have described. An ordinary purging dose, administered two or three days in succession, generally stops them; and, by a more frequent repetition, is certain of producing this effect. The cases in which the most powerful, and apparently the most appropriate remedies have been used in

Fig. 1 (upper). Case 1. Postero-anterior views of both wrists. In the left, the ulna is shortened and does not articulate with the wrist.

Fig. 2 (lower). Case 1. Postero-anterior views of both hands. Note that the left is claw-like. There are no bone or joint changes.

vain, and those in which this mode of treatment has been attended with success, are so numerous, that no doubt can exist of the efficacy of this prescription."

CASE REPORTS

Case 1. *Family History.*—The grandmother of Case 1 states that there was no history of bleeding for three generations preceding her. Four children were born to her.

1. A son, who died at the age of 55, was not a bleeder.

2. A son who died at the age of six years from a tooth extraction, living three weeks after the extraction. He had shown only one previous tendency to bleeding, from a deeply lacerated scalp.

3. A daughter who died during pregnancy with "flu." (*A*, This daughter had one son who died at the age of 17 months from a circumcision, living one week after the circumcision.)

4. A daughter who had the following children: (*A*, A boy, now 16 years of age, a bleeder [Case 1, reported in detail herein]; *B*, a daughter, normal; *C*, a son, born 10 years previously, a bleeder. This boy was circumcised at the age of two months. He was given injections of human blood twice within three days, which stopped the bleeding. He was never affected with swollen joints. He had had three transfusions at various times for injuries in the mouth. He died two years ago from brain concussion caused by falling off his bicycle onto the

Fig. 3. Fig. 4.

Fig. 3. Case 2. Right knee. The intercondyloid notch is deepened and widened, and there is irregularity of the spine. There is a marked absorption of the inner semilunar cartilage.

Fig. 4. Case 2. Right ankle. There is absorption of cartilages between the tibia and astragalus, and, also, between the astragalus and os calcis. There is an increase in the density of the bones adjacent to their articulations.

curbing. *D*, a son, eight years old, normal. *E*, a son, five years old, normal.)

Personal History.—Age, 16 years. The first signs of the disease appeared when circumcised on the eleventh day; bleeding was stopped after three days by transfusions and injections of various medicines.

Fig. 5. Case 2. Right elbow. There is an enlargement of the head of the radius and of the olecranon process. There are punched-out areas in the olecranon. The lower end of the humerus, head of the radius, and the olecranon process of the ulna show rarefaction.

At the age of seven months, the right shoulder was injured, resulting in pain. An x-ray examination at this time was negative.

During the period between the ages of one and six years, the following instances occurred:

From the time he began learning to walk (at 13 months), until he was 18 months old, he carried large bumps on either side of his forehead from falling while walking.

When two and one-half years old, he had a very severe attack of tonsillitis, with swelling of the throat and inability to talk. At this time his kidneys did not function, necessitating the use of a catheter. From the date of this illness, he had difficulty in learning, also in keeping his balance. This instability resulted in several falls which caused mouth injuries, requiring injections of blood and medicine to control the bleeding.

At the age of five years, a swelling started in the right elbow, extending to the wrist, then the fingers, also to the shoulder, accompanied by intense pain, which continued for a week or more. At this time the pain subsided, leaving the joints slightly discolored. This discoloration gradually became darker and later turned a yellowish shade. This cleared up in about six weeks, leaving the wrist twisted and the fingers drawn. Olive oil rubs were beneficial, but if the joints were forced the swelling appeared again. The wrist has remained stiff, but with the exception of the third and fourth fingers, which are still slightly affected, the other fingers have straightened.

The patient had a similar spell with the left arm at the age of eight years, leaving the wrist twisted and stiff and the fingers drawn; however, he can grasp objects with his left fingers.

On two or three occasions, he has had a swelling of the right ankle with severe pain, resulting in turning in of the foot, but the joint has not stiffened.

At the age of 13 years, he slipped and fell, severely injuring his left knee. The knee was stiff for a year, gradually returning to normal. In the last ten months, he has had two similar falls, again weakening this knee. It is improving slowly at the present time.

At the age of 14 years, while attempting a high jump over a fence, he caught his foot, which threw him to the alley pavement on his left side. He had severe pains over the left kidney for ten days, followed by voiding of bloody urine. He was given a transfusion of 400 c.c. of blood, without checking the hemorrhage. Thirty-six

hours later, he was given another transfusion of 240 c.c. of blood. A slight trace of blood showed in the urine for ten days after this. This fall also injured the left knee again, though slightly.

He has always been very active, although he takes cold easily, which is usually followed by a swollen joint somewhere; those mainly affected being the right ankle, left shoulder, and left elbow. There have been long periods, two or three years at a time, when he has had only slightly swollen joints.

Roentgen Findings.—Left shoulder joint: The shoulder is somewhat enlarged; no abnormality is shown in the films taken. Left elbow: There is a small area of decreased density in the external condyle, and a similar area in the olecranon process. Left wrist: The ulna is shortened; it does not articulate with the wrist. Left hand: Claw-like. There are no bone changes. Left knee: The intercondyloid notch is deepened and widened. There is an area of decreased density on the external part of the epiphysis. There is a widening of the space between the tubercles of the spine, and there are areas of rarefaction between the tubercles and beneath the spine. Right wrist: There is a slight widening of the lower end of the ulna. The wrist and hand are normal. This hand has spells of flexion of the fingers which can gradually be overcome. Right

Fig. 6. Fig. 7.

Figs. 6 and 7. Case 3. Anteroposterior and lateral views of the left knee. There is a widened and deepened intercondyloid notch, a punched-out area above the external condyle, flattening of both tubercles of the spine of the tibia, and irregularity of the articular surface of the internal tuberosity. There is rarefaction of both condyles of the femur, and a small exostosis on the anterior surface. There is rarefaction of both tuberosities and of the patella.

hand: There are no bone changes. Right foot and ankle: Normal. Hip, back, and pelvis: Normal.

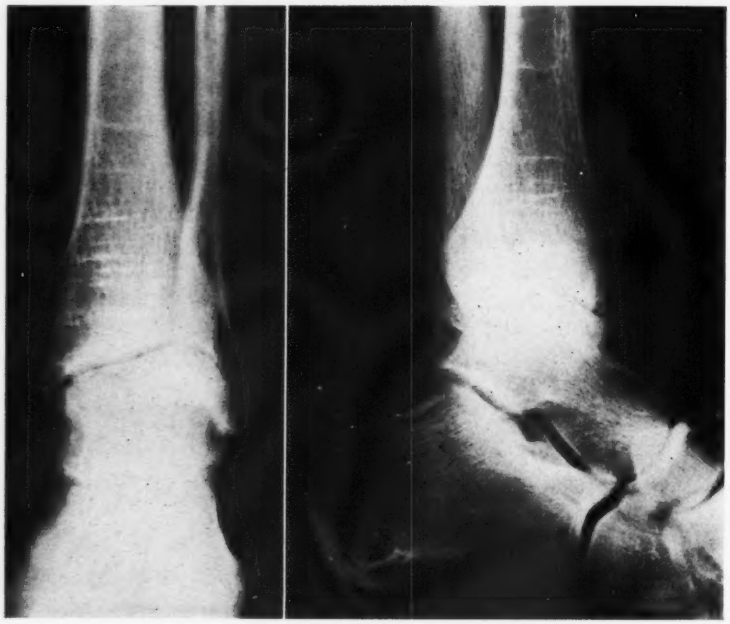

Fig. 8. Case 3. Right ankle. A narrow joint space is present, indicating absorption of the cartilage. Note the following: (*a*) Punched-out area close to the internal malleolus; (*b*) absorption of cartilage between articulation of astragalus and os calcis, and (*c*) transverse ridges in bone structure of lower end of tibia.

Case 2. *Family History.*—Mother's brother died of hemophilia at two years of age. His mother's sisters had three sons, all of whom died of hemophilia.

Personal History.—Male, 56 years of age. From infancy he has had spells of bleeding, several of which were extremely severe. We examined him for a hemorrhage into his left hip recently. In May, 1938, the coagulation time was 40 minutes; bleeding time, one and one-half minutes; blood platelet count, 180,000.

Roentgen Findings.—Both hips: Negative. Right knee: The intercondyloid notch is deepened and widened, and there is irregularity of the spine. Left ankle: There is absorption of cartilage, and an irregularity of the articulation between the astragalus and os calcis. Right ankle: There is absorption of the cartilages between the tibia and astragalus, and also between the astragalus and os calcis. There is an increase in the density of the bones adjacent to their articulations. Right elbow: There is an enlargement of the head of the radius and of the olecranon process. There are punched-out areas in the olecranon. The lower end of the humerus, head of the radius, and the olecranon process of the ulna show rarefaction.

Case 3. *Family History.*—The mother (Mrs. J.) of Case 3 states that there were four children in her family—three brothers and herself. The only aunt was a maiden lady. There was no history of hemophilia in the preceding generations. Mrs. J. had three sons, two of whom were hemophiliacs.

1. One son died at the age of 15, due to a ruptured bladder from a kick while scuffling. He was operated upon, but died in a few days from hemorrhage. At the age of two years, he had swollen

joints, mainly involving the wrist and ankles; the fingers and toes were not involved. At the age of six, he bit his tongue and it was impossible to stop the bleeding for two weeks. He bled profusely when his baby teeth erupted.

Fig. 9. Case 3. Right hand. Showing absorption of cartilage between the radius and scaphoid.

2. Son, aged 30; living and well. His appendix has been removed, and he has had an operation on his nose. He has had no abnormal bleeding.

3. Son, aged 36. (This is Case 3.)

Personal History.—Married, no children. This patient stated he always bruised easily. He bled when his baby teeth were extracted and bled through the stitches when an accidental wound had been sewed up. At about the age of ten, he twisted his right ankle; it swelled and he had to walk on crutches; returned to normal in about five to six weeks. He has had trouble with the right ankle at least ten times, but apparently is well between attacks. The left ankle also becomes swollen, but not as much as the right. The left knee was injured 15 years ago and still bothers him some; the right knee has been swollen and stiff, but does not bother him at the present time. Eight years ago he injured the left hip and was in bed for two weeks on account of hemorrhages into it: remained swollen for a year. At the age of 23, he was injured internally by a fall: in the hospital for a week, but the internal bleeding stopped without an operation. He bled for eight days following the removal of one tonsil by electrocoagulation, at the age of 28. His left leg was paralyzed for six months following a blow over

the left hip. At the present time, he says he has pain in the back, but it is not stiff. His shoulder pains him at times, and his neck becomes stiff. The wrists and fingers swell occasionally, but they appear to be normal now. The left leg is swollen and shorter, due to atrophy. He has been given blood infusions and amniotin at various times. His coagulation time has been 28 minutes and up.

Roentgen Findings.—Both hips: No changes. Left knee: There is a widened and deepened intercondyloid notch, a punched-out area above the external condyle, flattening of both tubercles of the spine of the tibia, and irregularity of the articular surface of the internal tuberosity. There is rarefaction of both condyles of the femur, and a small exostosis on the anterior surface. There is rarefaction of both tuberosities of the tibia and of the patella. Right knee: There is a slight irregularity and deepening of the intercondyloid notch. Both tubercles of the spine are sharpened. There is a punched-out area beneath one tubercle, and punched-out areas in the patella. Right ankle: A narrow joint space is present, indicating absorption of the cartilage. There is (1) a punched-out area close to the internal malleolus; (2) absorption of cartilage between the articulation of the astragalus and os calcis, and (3) transverse ridges in the bone structure of the lower end of the tibia. Left elbow: There is slight enlargement of the joint, irregularity and enlargement of the head of the radius, and irregularity of the external condyle of the humerus. Right shoulder: There is some absorption of cartilage, also punched-out areas in the head of the humerus. Right hand: There is absorption of the cartilage between the radius and scaphoid.

CONCLUSION

The fact that characteristic joint disease occurs in at least 80 per cent of hemophiliacs is not generally recognized by the medical profession. There are really two stages: (1) Acute hemorrhage into the joint and (2) the chronic stage in which changes in the joint are produced by these hemorrhages.

Again I wish to emphasize the careful elimination of hemophilia as a causative agent in both acute and chronic disease of the joints, and the fact that characteristic joint changes occur in hemophiliacs. In the three cases reported in this paper, surgeons have repeatedly suggested or attempted operations, not realizing that the joint changes were due to hemophilia.

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THE MEASUREMENT OF TISSUE DOSAGE IN RADIATION THERAPY[1]

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THE measurement of tissue dosage, and its expression in terms of a satisfactory unit, are questions continually before radiologists at the present time. It has long been conceded that it is desirable to know the quantity of radiation delivered to the tissues undergoing treatment. It is recognized that, since biological changes are very probably due to ionization produced in the irradiated cells, the dosage unit should be based on some form of ionization measurement. It would, of course, be highly desirable to measure the ionization actually produced in the tissues.

Since up to the present time this has not been feasible, it is necessary to use the ionization in a gas in some manner as the standard. Failla has suggested that the tissue dose unit should be based on the ionization produced in a certain mass of air at a given point in a given medium, under the conditions in which the radiation is to be utilized (1). The actual number of ions chosen as the unit could well be the number corresponding to the international roentgen, namely, 4.19×10^9 per cubic centimeter of air under standard conditions, which amounts to 324×10^{10} per gram of air. In this case a modification of the definition of the roentgen, such as is contemplated at this Congress, would make it possible to express air and tissue doses in terms of the same unit.

It is recognized that any unit proffered at the present point in the development of the problem may be imperfect. The great need at the moment is not the attainment of physical accuracy, so much as it is the securing of consistency among radiologists in specifying dosage. When the physicists shall have worked out a satisfactory unit, data recorded under any reasonable scheme can be transferred to the new unit with sufficient accuracy for all clinical and biological purposes.

It will be desirable, however, not to speak of tissue doses measured in terms of this unit as being measured actually in roentgens. For convenience, and for want of a better term, they may for the present be referred to as "tissue roentgens." It will be wise to keep some such means of distinguishing them from true roentgens until the whole matter of dosage units is settled.[2]

In discussing tissue dosage in radiation therapy, it is usually desired to know the quantity of radiation delivered to each skin portal, and the total dose administered to the diseased region. In order to measure this dose in terms of tissue roentgens, it would be necessary to have an instrument which would measure accurately the number of ions per gram of air, produced at the point where the radiation is utilized. On the other hand, if it could be determined once for all how the tissue dose at any point is related to the roentgens per minute in air at the position of the skin portal, then the dosage for any particular treatment could readily be calculated.

Many attempts at actual measurement of tissue dosage have been made. It has been known for several years that, with certain precautions, small ionization chambers can be constructed which will measure x-rays correctly in air, within a certain range of wave lengths. It has frequently been assumed that any good "air

[1] Presented before the Fifth International Congress of Radiology, at Chicago, Sept. 13–17, 1937.

[2] The new definition of the roentgen, adopted by the Units Committee of the Fifth International Congress of Radiology, Chicago, 1937, still does not, in general, do away with the necessity for distinguishing between air dose and tissue dose.

wall" thimble chamber could be used on the surface of a phantom, or even of a patient undergoing treatment, to determine the actual skin dose. Even when the dose thus obtained was not actually expressed in roentgens, it was assumed that a true measure had been made of back-scatter. In a similar manner, measurements made with such a chamber in the depths of a phantom, or actually inserted into body cavities, have been assumed to express correctly the tissue doses.

In a review of the literature published during the last ten years, nine papers have been found which reported extensive measurements on back-scatter with this type of ionization chamber, using water or wax phantoms. All of these chambers were stated to be independent of wave length over a wide range of qualities. Yet the values for back-scatter, for the same field and focal distance, for radiation of half value layer 1.0 mm. copper (a quality frequently used in therapy) vary from 22 to 63 per cent (2)! It is evident from this that the accuracy of surface measurements made with such chambers is questionable, even under the carefully controlled conditions in the laboratory. They must be even less accurate if made on the body of the patient at the time of treatment, particularly if any type of cone is used with the x-ray tube holder.

The whole question of the proper type of ionization chamber for making such measurements deserves careful consideration. The thimble chamber has several inherent sources of error, which may or may not give rise to serious variations in the results, but which cannot be ignored. These sources of error lie partly in the wall and stem material of the chamber and partly in its size and shape. Even if it is satisfactorily "air wall" for the primary beam, it may not be so for the very soft components of the scattered radiation. Since the quality of the scattered radiation changes continuously with increasing depth in the material, any wall effect of the chamber will vary with its position in the phantom. The stem will shield the chamber from part of the scattered radiation, and may at the same time contribute scattered and secondary radiation of its own, different in quality and quantity from that which it has absorbed. In addition, chambers of this type usually have a directional effect. Also the air volume of the chamber may, by its very presence, change the situation with respect to the ionization at the point at which it is attempting to measure it. The actual depth represented by a given measurement may not be that of the center of the chamber, but something either more or less.

The net result of all these possible errors will vary, of course, for different chambers. In any specific case, it is not possible to state *a priori* how significant it may be. This can be determined only if a chamber for tissue dosage measurements can be developed which is free from the above-mentioned errors, and has none of its own equally serious. If such a chamber is available, then any thimble chamber can be compared with it, just as it can with a standard air chamber, and its range for reliable measurement determined.

The extrapolation type of ionization chamber, devised by Failla, is very useful for such measurements (1). It is shown diagrammatically in Figure 1, and consists essentially of two parallel plates which can be set at different distances apart. The lower one, B, is of celluloid 3 mm. thick, coated with India ink to make it electrically conducting. In the center of this sheet, a circle 3 cm. in diameter has been scratched clean of ink with a pair of dividers, thus providing an insulating division between two areas. The region within the circle is the lower electrode of the chamber, attached to the measuring instrument by a fine aluminum wire, D, as indicated. The region outside the circle is grounded, acting as a guard ring. The entire celluloid sheet forms the top, or cover, for the back-scattering phantom, which in this particular instrument consisted of a large aluminum pot, A, filled with rice, with a little flour added. Any desired substance can be used instead; the

matter of phantom material will be discussed later. The entire upper plate, E, is charged to a potential somewhat greater than that required for saturation; the actual ionization chamber, however, is the volume of air, C, between the lower electrode—the 3 cm. circle—and the upper plate. The frame carrying this upper electrode, F, is demountable, and four separate ones are provided, with plates varying in thickness from thin silk chiffon to several millimeters of organic material, each being coated with India ink. This upper electrode is mounted on the tops of three micrometer screws, H, so that any desired spacing may be obtained between it and the lower one, down to a fraction of a millimeter.

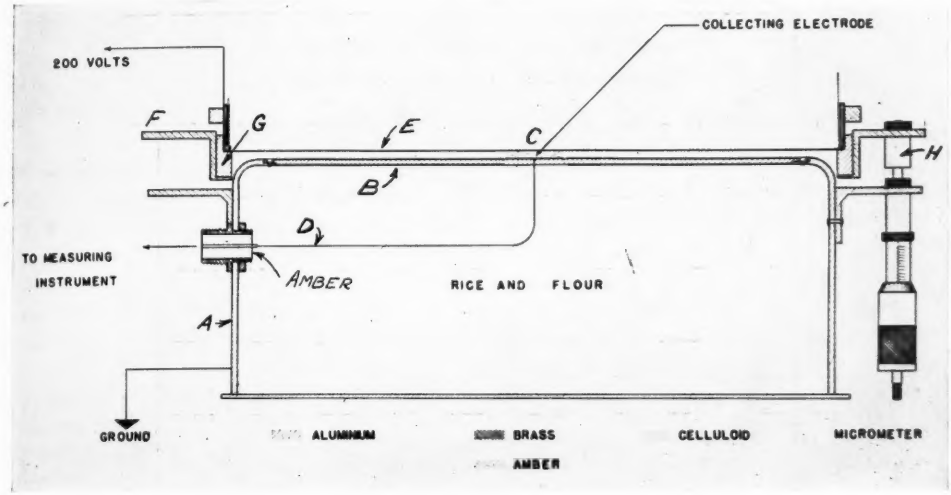

Fig. 1. The Failla extrapolation ionization chamber.

A detailed discussion of this chamber has been published (Failla, see above), but certain points should be mentioned here. For measurement of the surface radiation, or back-scatter, the lower electrode is actually a part of the scattering phantom. By changing the upper one, any wall effect may be studied. Between the chiffon electrode, just mentioned, and a drum skin (parchment 0.2 mm. thick) no difference was found, down to radiation of half value layer 1.0 mm. aluminum (equal to 0.03 mm. copper). For measurement within the phantom, the electrode is a layer of the organic material to be discussed presently. Additional layers of the same substance can be piled on this electrode to any desired total. Both upper and lower walls of the chamber for depth dose measurements are thus actually part of the phantom.

The effect of the air volume can be determined by varying the distance between the plates. The micrometers cannot be set to read electrode separation directly; for a given setting the separation may be different for different atmospheric conditions, and is almost certain to be different for different electrodes. However, by the simple method of determining the electrical capacity of the chamber as a parallel plate condenser, the separation can be readily calculated. The area of the electrode is 6.35 sq. cm. The plates are set as close as possible (about 0.5 mm. apart) and a reading of the ionization current is made. The spacing is then increased by 1 mm., which means an increase in volume of 0.635 c.c. The difference in ionization readings then represents the ionization in

this volume. By separating the plates another millimeter, the ionization in the next 0.635 c.c. can be determined. If this

units, the actual number of ions per cubic centimeter (or per gram of air) can thus be measured at any point within the phantom.

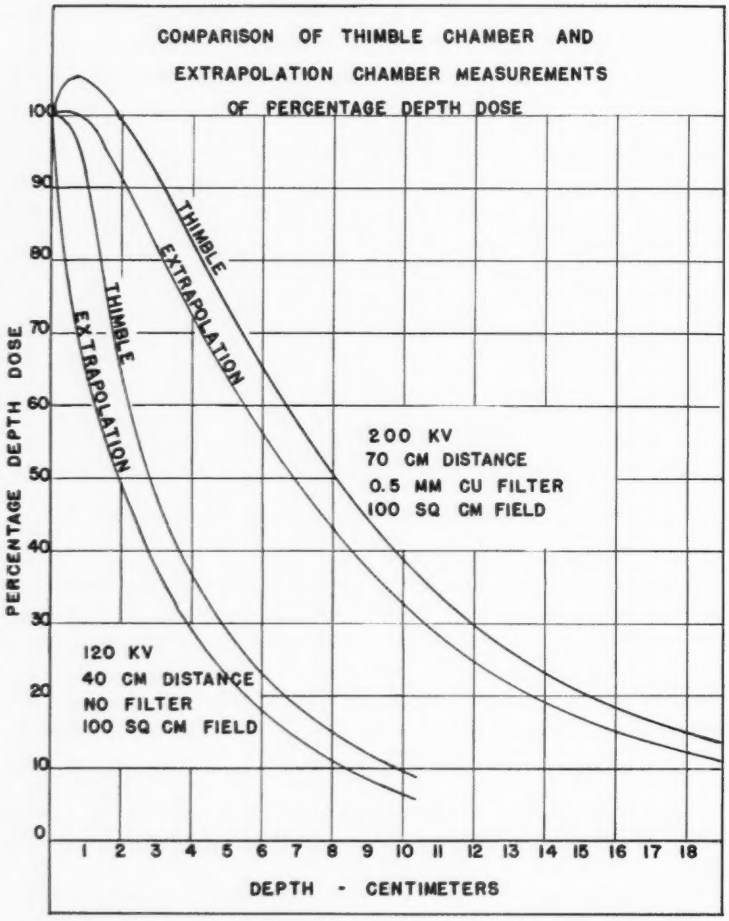

Fig. 2. Curves showing comparison of thimble chamber and extrapolation chamber measurements of percentage depth dose.

is the same as the first, the chamber is thus far independent of volume effect. That is, the number of ions formed *per cubic centimeter* of air is constant. This has been found to be the case, up to four- or five-millimeter separation, for the several qualities of x-rays studied up to the present time, both on the surface and in the interior of the phantom. If the measuring instrument is calibrated to read in electrostatic

The level to which this measurement refers can be determined within a fraction of a millimeter.

When the chamber was first built, it was not expected that the ionization per cubic centimeter would be independent of the ionized volume within the limits just mentioned. The original plan was to determine the ionization per cubic centimeter for gradually decreasing volumes, plot a

curve from these data, and extrapolate it to a vanishingly small volume, thus obtaining the ionization per cubic centimeter effectively at the surface of separation. It was from this plan that the chamber was given its name. This procedure seems to be unnecessary within the range of ordinary x-ray therapy, as just stated. No experiments have been made as yet with x-rays of greater half value layer than 2.5 mm. copper. In the work with gamma rays, extrapolation was necessary. This, however, is in part because of the relatively short distances between the ionization chamber and the radium. A change in the electrode separation altered the radium-chamber distance, as the apparatus was set up. Other factors may have been introduced by the geometry of the radium container (the four-gram radium element pack), so that at this time no conclusions can be drawn regarding what is to be expected from super-voltage x-rays. Nor is any information as yet available with regard to wave lengths longer than those used in superficial therapy.

Figure 2 shows a comparison of depth dose curves obtained with one particular thimble chamber and with the extrapolation chamber, with the same phantom material, for two widely different qualities of radiation. It is observed that in all cases this thimble chamber gives higher percentage depth doses than the extrapolation chamber, and that the percentage difference between the two is not constant.

For application to clinical problems, the material of the phantom is of great importance. Various substances have been used by different workers, mainly water, grains such as rice and wheat, and various waxes. Water, being a liquid and a conductor of electricity, offers experimental difficulties; the waxes have too high a hydrogen content to be satisfactory tissue substitutes; the grains, by their structure, make accurate measurements near the surface difficult. Certain organic substances available in sheet form have been subjected to various laboratory tests (2). The most satisfactory substance thus far found is a commercial compressed cellulose product by the name of "pressdwood." This fulfils the requirements as to composition and density, is readily obtainable, and easy to handle. Accordingly it has been used as the phantom material in measurements made recently.

With the extrapolation chamber it is possible to determine the numerical relation between the number of ions per cubic centimeter (or per gram) in air and at any point within the scattering medium, irradiated according to any set of physical factors. It is, of course, also possible to calibrate a thimble chamber against the extrapolation chamber for any set of conditions, and then to use it to measure the tissue dose directly. *In such a case the thimble chamber can be correctly used only in the region in which it has been calibrated, both as regards quality of primary radiation and position within the phantom.* This procedure is, however, unnecessary. As was stated earlier in this paper, if the ratio between the tissue dose at any point and the air dose at the position of the skin portal is known, for a given set of treatment conditions, the tissue dose can be readily calculated when the output of the machine in air is known.

Since the x-ray machine is calibrated in terms of roentgens per minute *in air*, the back-scatter and depth dose factors may be given in such a form that the ions per cubic centimeter or per gram of air (or "tissue roentgens" per minute) can be immediately determined, or they may be given in the more familiar percentage form, which is of use mainly in expressing tissue doses in terms of erythema doses. Thus, for x-rays generated at 200 kv., with half value layer 1.0 mm. copper, for a filter of 0.5 mm. copper and a field of 100 sq. cm., the skin dose as determined by the extrapolation chamber is 1.36 times the air dose (or the back-scatter is 36 per cent). If the x-ray machine delivers 60 r per minute in air, it delivers 60 × 1.36, or 82 tissue roentgens per minute in the skin at the same distance, in the center of a field of 100 sq. cm. At the same time, for a focal-

skin distance of 70 cm., the intensity at a depth of 10 cm. is 45 per cent of the *air intensity just specified;* 45 per cent of 60 is 27 tissue roentgens also. The advantage of calculating depth doses directly from air doses is, of course, that it eliminates one

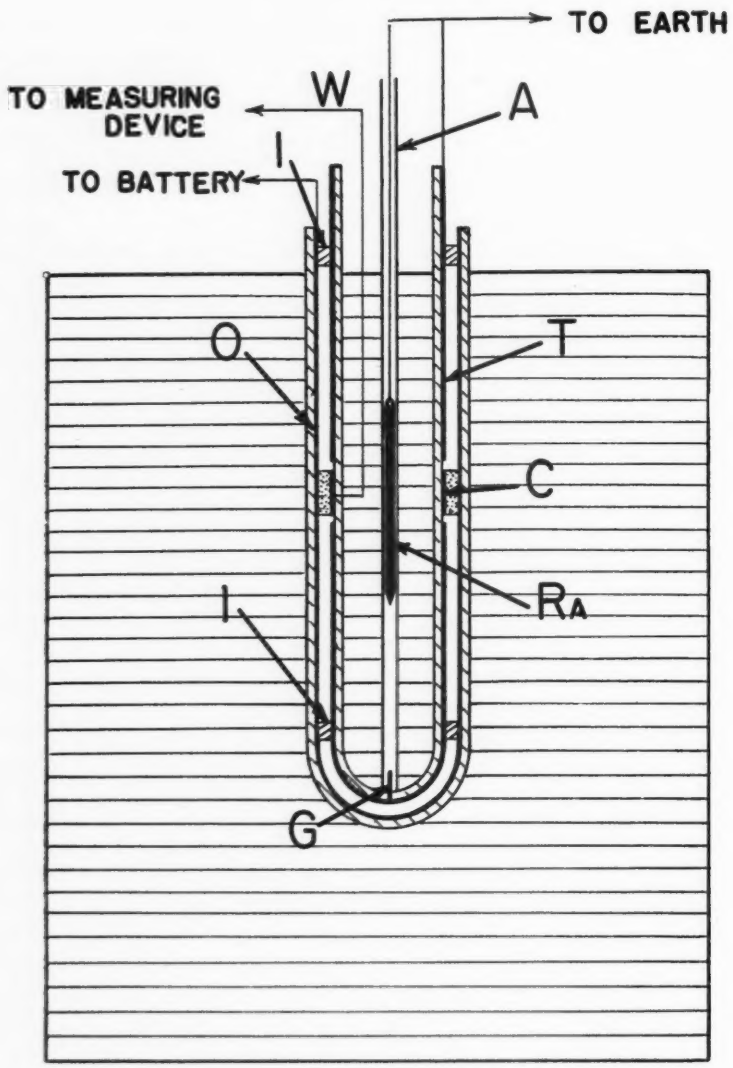

Fig. 3. Extrapolation chamber for the measurement of tissue doses in interstitial radium therapy.

27 tissue roentgens per minute. This method of calculating depth dose is not so familiar as that of saying that the depth dose under these circumstances is 33 per cent of the skin dose; 33 per cent of 82 is step in the calculation. As long as depth doses were to be expressed only in terms of the percentage of the skin dose, and all tissue doses were specified in terms of erythema units, the second method just

given was necessary. At present, however, the tendency is toward expressing all doses in terms of the physical unit, which we are calling the tissue roentgen.

A very extensive series of measurements of surface and depth doses, for a wide range of qualities of radiation, is being made with the extrapolation chamber. Data for surface doses have been published (2). Those for depth doses will appear in future communications.

It must be remembered that in making dosage calculations, *all* the physical factors must be accounted for. It has been often the case that depth dose measurements made in a large phantom were applied to treatments in much smaller volumes. In order to obtain correct data for parts of the body such as the neck and limbs, it is essential to use a phantom much smaller than the ordinary one. Tissue doses for tangential irradiations cannot be properly obtained from isodose charts made with the beam of radiation entering the body at right-angles, nor can the exit dose (dose delivered to the skin by the beam emerging from the body opposite the port of entry) be obtained from such charts. The dose at any depth in a phantom has a considerable contribution from material lying still deeper, and this contribution is entirely, or almost, missing from the exit dose. Such a dose should be determined with the chamber actually on the exit surface of a phantom of the correct size. In irradiation about the head or limbs, the exit dose may assume considerable significance.

In this connection it must not be lost sight of that the effect produced by a given number of tissue roentgens in any tissue may be dependent on the quality of the radiation. This has been demonstrated to be very definitely the case with regard to the skin. For instance, for fields of 70 sq. cm. on the forearm, the threshold erythema reaction is produced by 525 r (measured in air) of radiation generated at 200 kv., having a half value layer of 1.0 mm. copper, and by 185 r of radiation generated at 85 kv., having a half value layer of 1.7 mm. aluminum. The tissue roentgens (obtained by multiplying the air dose by the correct factor including backscatter) are, for the first 1.33×525, or 700, and for the second, 1.23×185, or 230. That is, it requires three times as much of the harder radiation as of the softer (measured in tissue roentgens) to produce the threshold erythema. Now the quality of radiation is constantly changing on passing through tissue, so that the quality for the exit dose is definitely different from that for the dose at the port of entry. Adding the two values of tissue roentgens may lead to an erroneous idea of the skin effect to be expected. Since the exit dose has been frequently neglected in dosage calculations, it would appear that such an error, in present-day therapy, would not be serious. However, it serves as an example of what may arise in attempting too close a correlation between physical measurement and biological reaction.

It would be considered an advantage to be able to express all tissue doses, whether from external or interstitial sources, in terms of the same unit. Up to the present time, attempts to measure gamma rays in terms of roentgens have not been in good agreement, even for measurements in air, and extension to tissue dosage has resulted in further uncertainty.

By a modification of the extrapolation chamber the same system can be used to measure the ions per cubic centimeter at any point in a scattering medium around a radium source. The method is shown diagrammatically in Figure 3. The inner electrode is a thin celluloid test tube, T, containing the radium source. Its outer surface is coated with India ink, and a band, C, separated from the rest by scratches (as was the circular electrode in the large chamber, Figure 1). This band is the collecting electrode, connected to the measuring instrument by a fine wire, W. A second thin celluloid test tube, coated with ink on the inside, forms the outer (charged) electrode, O, the two tubes being mounted concentrically by means of insulating rings, I. Tube T is filled with water, and the whole immersed in a phan-

tom as shown. In the use of this chamber the effect of the inverse square enters even into very small changes of thickness of chamber, so that the ionization per cubic centimeter is not independent of volume for any range whatever. Hence the extrapolation scheme must be resorted to. This is done by using outer test tubes of different diameters. With such determinations, unless the ionization changes very rapidly with volume toward the limit, the method should give much more accurate data than any other heretofore employed.[3]

Discussion of tissue dosage in the present paper has been entirely on the basis of physical measurement. It must, however, not be lost sight of that biological questions connected with the rate of administration—the fractionation and protraction of treatment—are also exceedingly important. In order to express clinically the total dose delivered over a period of time, some means must be found to express the net biological effect, allowing for tissue recovery, as well as the total physical dose. Such work is outside the scope of the present paper, but it is important to remember that, even when the physical questions are settled, the problem of tissue dosage measurement has been only partially solved.

[3] Since the presentation of this paper, considerable work has been done with small extrapolation chambers of this type. They have been found very satisfactory.

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DOSAGE MEASUREMENTS BY SIMPLE COMPUTATIONS[1]

By HERBERT M. PARKER, M.Sc., Christie Hospital and Holt Radium Institute, *Manchester, England*[2]

THE logical basis of tissue dosage, to the physicist, would be the actual increase of energy per unit volume of tissue brought about by irradiation. Direct methods of measuring dosage in these terms are not practicable, but the same object is served if an indirect means giving equivalent results can be set up. The conditions under which ionization measurements can be used for this purpose have been the subject of exhaustive investigations, notably by L. H. Gray. Briefly, Gray's conclusions may be summarized as follows:

The energy absorption per unit volume of a medium in which quantum radiation is being absorbed is proportional to the ionization per unit volume arising in a small air-filled cavity in the medium. The cavity must be situated at a depth in the medium not less than the maximum range of secondary electrons in the medium, and the linear dimensions of the cavity must be small compared with the range of the corpuscular radiation. Transcribing these conditions to conform with measurements in small ionization chambers it is seen that the wall thickness must be equal to the range of secondary electrons and that the proper linear dimensions vary from a few millimeters for gamma rays to one-tenth of a millimeter for x-rays generated at 200 kv. In principle then, it is possible to measure tissue doses by observations on the ionization in small chambers having tissue-equivalent walls. The limiting dimensions of the chambers are so small for x-rays at normal voltages that grave, perhaps unsurmountable, experimental difficulties are introduced. For this reason it has been proposed that all dosage measurements should be related to observations in chambers having air-equivalent walls, and a revised definition of the international roentgen has been put forward on this basis. With air-equivalent walls the total ionization is strictly proportional to the volume of the chamber which can, therefore, be chosen of more practicable size.

Now under most ordinary conditions the tissue to be treated consists entirely of elements of low atomic number and the specific gravity is reasonably constant, so that the observed ionization per cubic centimeter in a minute tissue-wall chamber would be exactly proportional to the energy absorption in tissue, and further, this ionization per cubic centimeter would differ by a constant amount (about 4 per cent) from that in an air-wall chamber of any size. Hence the proposal to measure tissue dose in roentgens by means of air-wall chambers is acceptable as a general principle. Nevertheless circumstances do arise in which the energy absorption in tissue is not directly correlated with the ionization in an air-wall chamber, as, for example, in the neighborhood of skin or bone where elements giving an appreciable photo-electric effect are to be found. It is felt that any new phrasing of the definition of the roentgen should not preclude the possibility of allowing for these special effects in the statement of tissue dose by a too rigorous insistence on the merits of measurements with air-wall chambers.

The problem of tissue-dose measurement is by no means solved when we have laid down satisfactory experimental conditions. It is not feasible to insert ionization chambers in tissue to measure the dose in roentgens directly, and if it were the labor involved in exploring the complete radiation field for each individual case would be prohibitive. The question is not so much how to measure tissue dose, but how to avoid its measurement. I want,

[1] Presented before the Fifth International Congress of Radiology, at Chicago, Sept. 13–17, 1937.

[2] Present address, Swedish Hospital, Seattle, Washington.

then, briefly to review the methods by which this can be accomplished in the light of the principles of measurement that I have outlined.

Although there is no sharp delineation in the theory of ionization measurements between x-rays and gamma rays, there is in practice a rather marked differentiation in the approach to dosage simplification for the two agents. For x-ray treatments the customary method is to use a series of isodose charts appropriate to one particular type of tube, together with tables of dosage rate for all the variations of tube voltage, current, filter, focus-skin distance, and field size to be employed. Many of these variables can be treated collectively if we postulate a change in the method of construction of isodose charts. Instead of writing 100 per cent as the surface dosage rate for each chart, let 100 per cent represent the dosage rate at a given point in air under standard conditions. The figures on isodose charts then give at once the tissue dose for the given incident quality of radiation for the focus-skin distance and field size in question. This assumes that the contribution of scattered radiation at any point depends only on quality, as measured by half value layer, and not on the spectral distribution. This appears to be valid over the range of variation that occurs in therapy. It assumes also that independent observations of the dosage rate in a measuring phantom under identical conditions of irradiation will agree. Figure 1 shows

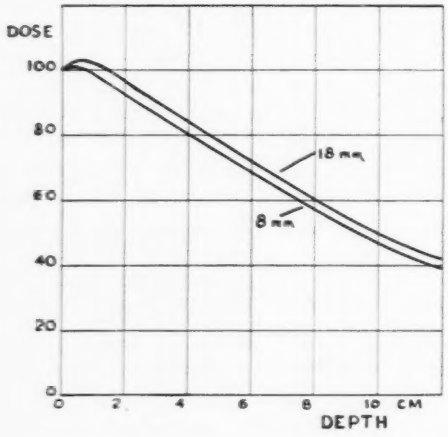

Fig. 1. Influence of chamber diameter on depth dose curves.

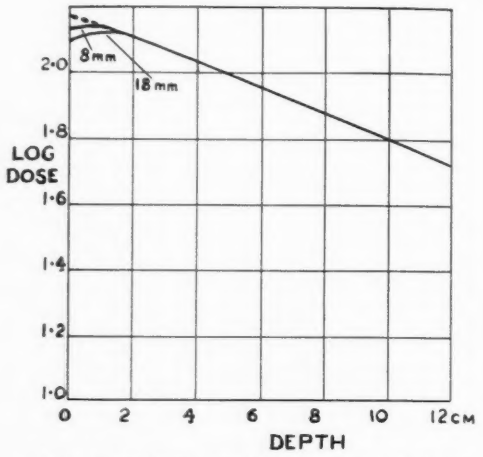

Fig. 2. Logarithmic depth dose curves set coincident at a depth of 5 cm.

curves of depth dose for 200 kv. radiation incident on a large block of unit density wax, as recorded by two chambers of diameter 8 mm. and 18 mm., respectively. Both chambers had air-equivalent walls and their response to radiations of H.V.L. 0.3 mm. Cu to 3.0 mm. Cu ran exactly parallel. Yet the two curves are quite different in shape. The initial reading in each case was made with the chamber half immersed so that it is not surprising that there should be a marked difference in behavior over the range in which each chamber proceeds to the fully immersed position. It is more important that the increased depth dose persists at all depths. Suppose the curves are redrawn (Fig. 2) to make them coincide at an arbitrary depth, which here is 5 cm. The curves now coincide exactly except near the surface and one is tempted to derive a true depth dose curve by extrapolating the common part to zero depth. The method would acquire physical significance if the actual dosage rates at this depth were equal but this is not so. The value was 3 per cent more

in the large chamber at 5 cm. depth, and 3 per cent less at the surface. The difference at 5 cm. depth is simply explained by the reduced thickness of wax to be traversed in the case of the larger chamber.

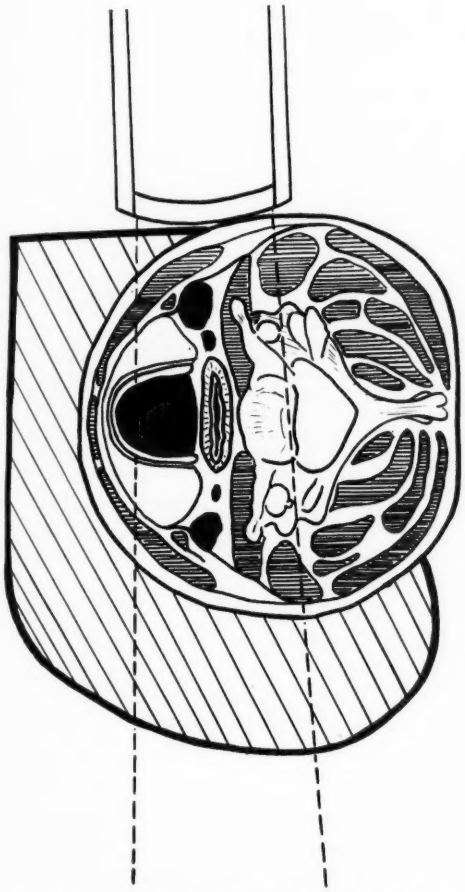

Fig. 3. Arrangement of wax block to bring a neck irradiation into approximate agreement with large phantom measurements.

We should expect an indefinitely small chamber to give readings some 3 per cent less again and this was verified by measurements in a chamber of 2 mm. diameter. At the same time, the apparent surface dosage rate rose by 3 per cent. The estimated shape of depth dose curve for an indefinitely small chamber approximated closely to the straight line in Figure 2, although the readings within 2 mm. of the surface were unreliable. The dependence of dosage rate or chamber size is given in Table I for a few special cases. To make isodose charts of general utility it will be seen that all the observations must either

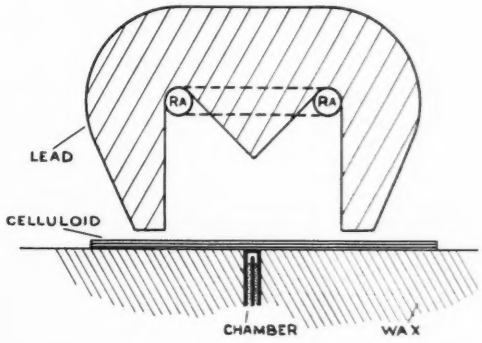

Fig. 4. Measurement of skin dose under conditions which generate copious secondary radiation.

be made with chambers much smaller than those commonly employed or corrected from measurements with two chambers. The use of small chambers is specially advisable when measuring the effects near the geometric edge of a beam the gradient of whose dosage rate is high.

The therapist equipped with a set of isodose charts derived from readings in a large phantom with beams at normal incidence desires to know to what extent they will be valid under the varying treatment conditions arising in practice. Better still, the physicist should define conditions under which the same charts may be used directly, so that the estimation of dosage can be kept in its simplest terms. The use of auxiliary scattering bodies to insure the restoration of equivalence between experi-

TABLE I.—DEPENDENCE OF DOSE ON CHAMBER DIAMETER

Chamber Diameter	Relative Dose	
	Near surface	5 cm. deep
V. small	143	100
8 mm.	138	103
18 mm	135	106

ment and practice in irradiations at oblique incidence, or of limited masses of tissue, such as limbs and necks, is a familiar procedure. General conditions, which should be regarded as an integral part of a dosage

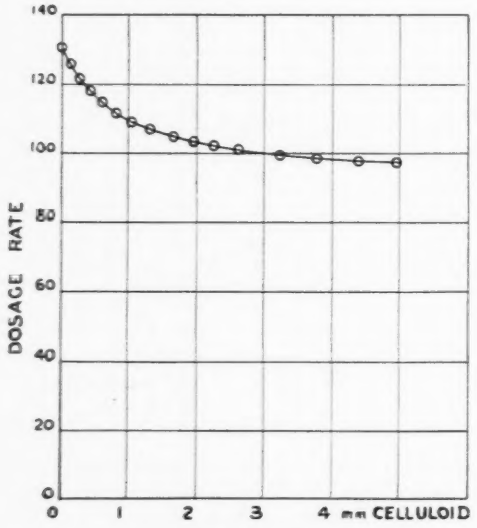

Fig. 5. Variation of skin dose with thickness of celluloid screen in Figure 4.

system, can be laid down. Thus for 200 kv. radiation full ionization is received at any point in the irradiated field when the scattering medium extends 8 cm. laterally beyond the geometrical limits of the beam and to 8 cm. beyond the point considered. For most purposes a thickness of 5 cm. is sufficient. The same thickness can be used over a wide range of radiations on account of the compensation between the penetration of the beam and the abundance of scatter. A typical application of the principle is shown in Figure 3.

Compensation for anomalous scattering regions within tissue is not feasible, but it appears, as, for example, in the measurements by Mrs. Quimby and her collaborators on cadavers, that the presence of bone or of small cavities does not seriously disturb the estimation of tissue doses from isodose charts. In some special cases, notably for lung cavities, a discrepancy arose which could be accommodated by a simple correction curve in such a way that the dosage for individual cases could be derived with a probable error not exceeding a small percentage. It may be claimed then that the tissue dose, which would be

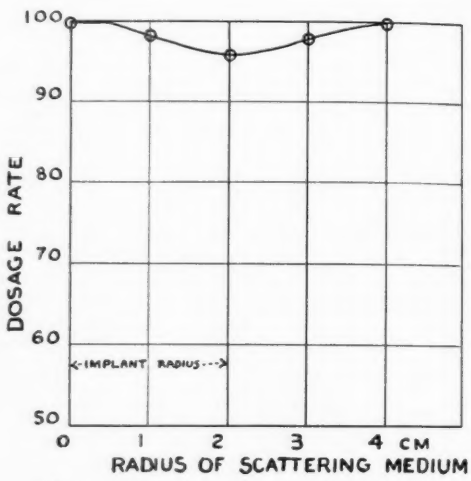

Fig. 6. Effect of scattering cylinders of various radii on the dose within a cylindrical radium implant. (Chamber wall = 1 mm. electron metal.)

recorded by a small air-walled chamber, can be written down within perhaps 5 per cent under all treatment conditions by simple computations from the basic charts and a knowledge of tube output.

It remains to be seen how far these measurements would be affected by taking into account the presence of skin, bone, and cartilage associated with tissue. It has been assumed so far that the energy absorption in tissue will be directly proportional to the measured ionization equivalent in air-walled chambers. It is evident that the true absorption in these particular substances may be quite different, mainly on account of the photo-electric absorption in the sulphur of skin, and the calcium and phosphorus of bone. L. H. Gray has estimated, for example, that the ionization in a minute chamber with skin-equivalent walls may well be 50 per cent in excess of that in a tissue-wall chamber for x-rays generated at 200 kv. Moreover, the range of this additional effect extends to about

80μ from the actual sulphur-bearing layers. Blood capillaries are found within from 40μ to 140μ of such layers. Consequently it may be expected that the additional effects will play a part in the production of visible erythema reactions. It will follow that tissue doses, regarded as energy absorption, but determined by convention in terms of the ionization in air-walled chambers, may be seriously in error for soft radiation in just the cases which have been subject to the most careful clinical investigation. For the present, the best one can do is to regard an erythema dose as not yet having graduated to the status of a physical dose. Ultimately it may be possible to make a sufficiently close approximation to the photo-electric contribution, which could readily be applied to isodose charts of the type that I have described. In the meantime, it would be unfortunate if the anomalies of skin dose were allowed to discourage the statement of tumor doses in roentgens.

The analogous effects in bone and cartilage do not give rise to problems of physical interest. It is obvious that zones of high dose will occur within and in the immediate vicinity of these bodies. These zones constitute a potential danger in treatment and their appreciation can safely be left to the clinician.

In comparison with the x-ray problems the measurement of absolute tissue dose with radium is straightforward. The difficulties diminish rapidly as the wave length of the incident radiation diminishes. The permissible dimensions of the chamber increase inversely as λ^2, and the disturbing photo-electric effect diminishes as λ^3. The choice of material for chamber walls is also much less critical, and well-established corrections can be employed to convert readings in such convenient materials as elektron metal to the conventional equivalents for air walls. Against this one has to set the increased wall thickness of the chambers required to exclude secondary corpuscles generated at distant points from the chamber. It is well known that a thickness equivalent to some four millimeters of graphite is necessary and sufficient for this purpose. This condition modifies the conception of tissue doses under two circumstances, namely, near a skin surface or close to a radium needle used interstitially. Figure 4 illustrates a typical experiment on the magnitude of the first effect. An apparatus similar to a radium bomb was used to irradiate a block of wax in which was inserted a small cylindrical chamber with its axis at right-angles to the surface. The walls of the chamber consisted of elektron metal and the upper end was machined to a thickness equivalent to 0.7 mm. of tissue. Successive layers of celluloid were applied to the phantom surface and the ionization was noted at each stage. The ionization was reduced by approximately 25 per cent by the addition of 3 mm. of celluloid (Fig. 5). The conditions in this experiment were exceptionally favorable for the generation of extraneous secondary particles, but in some radium treatments the state of affairs is not dissimilar. For the sake of consistency, an adequate layer of celluloid, wax, or similar material should be placed on a skin surface during irradiation by external sources, so that the dose at a superficial point is derived entirely from the ionization produced by corpuscular radiation generated in the immediate vicinity.

The analogous effect round a radium needle in tissue is of little importance. It occurs in a region where the gamma-ray dose is already in excess of the general value and the extra ionization arising from secondary β particles produced in the needle wall merely shortens the total time for which a given needle can be safely left *in situ*.

Apart from these two effects the estimation of tissue dose for gamma radiation presents the fullest scope for simple calculation. Once the dosage rate in roentgens at one centimeter from a point source of one milligram of radium with standard filtration has been determined, the tissue dose at any point can be written down in general without further reference to ionization measurements. This basic value has

been the subject of exhaustive investigation by radiophysicists, and the more recent measurements have converged to a figure which can probably be written as 8.3 ± 0.2 roentgens per hour with 0.5 mm. Pt filtration.

Three types of radium treatment, which are amenable to different methods of dosage simplification, can be distinguished. These are the so-called bomb therapy, irradiation by radium moulds, and interstitial therapy. Dosage estimation in bomb therapy proceeds by means of isodose charts constructed in a manner identical with that for x-ray therapy. With radium moulds the determination of dose is particularly easy. One is normally concerned with conditions in the first few centimeters of tissue and within this range the net effect of absorption and scattering on the dose received at any point is so small that it can, in general, be neglected. The determination of dose thus becomes a purely mathematical exercise. Simple solutions depend upon the possibility of stating rules for the distribution of radium sources so that the dosage rate shall be approximately uniform and calculable over sheets parallel to the radium applicator. The complexity of any such system of rules is fixed primarily by the degree of accuracy to which the dose is made uniform over a given surface. Considering the inevitable error in the measurement of a treating distance of the order of one or two centimeters, a margin of error of ±10 per cent is not unreasonable. This gives sufficient scope for generalizations which lead to a system of dosage calculation whereby the tissue dose at any relevant point can be written down at once when the area of the radium applicator, the treatment distance, and the effective radium content are known.

The extent to which the absorption of the primary radiation in tissue will influence a tissue dose calculated in this way depends very much on the geometrical arrangement of each particular case. It is probably for this reason that the reported values of the effective absorption are not consistent. It seems to be agreed that the net absorption is not more than 4 per cent per centimeter; measurements that I have made suggested that a value of 2 per cent per centimeter would be a fair average. In view of the incidental errors of this type of therapy, it seems unnecessary to apply an absorption correction to depth doses up to 3 cm. deep.

Conditions in interstitial radium therapy are rather different. On paper, at least, it is possible to give rules for the distribution of radium sources in space in such a way that the dose will be approximately uniform throughout the volume contained, except within a few millimeters of each source, and can be calculated from the total volume and the effective radium content. These proposed arrangements have been set up in the laboratory and the radiation field explored by small ionization chambers. The dose in air has invariably been found to be consistent with the calculated value and the change in dose by immersion of the whole arrangement in a scattering medium of unit-density has been shown to be negligible. Actually, the dose reaches a minimum when the scattering medium just occupies the space contained by the needles (Fig. 6). With a phantom approximating to real conditions the tissue dose is never far from the air dose. At first sight, then, the calculation of dose in interstitial therapy would appear to be the simplest possible case. This would be true if radium needles could be inserted in predetermined positions, which is clearly impossible. The problem of dosage thus becomes the purely geometrical one of determining the actual configuration of sources in a radium implant. In some cases a study of two radiographs of the implant is sufficient for this purpose, but more generally it is essential to reconstruct the implant in space. To take an extreme case, the series of implants shown in plan in Figure 7 can be arranged to give identical radiographs in both anteroposterior and lateral films. The dose at a point A changes in this series by a factor of five. In real practice one can expect errors up to perhaps 50 per cent, if the dose is estimated from radiographs

alone. For this reason we have to regard the spatial reconstruction, which can be readily performed by optical means, as an integral part, and in fact the principal part, of the mechanism of dosage estimation.

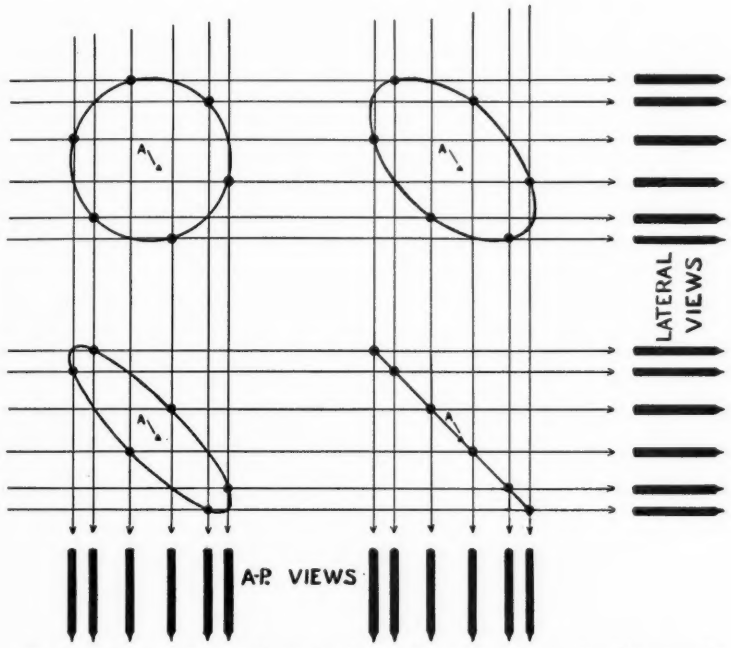

Fig. 7. Identity of the radiographs of four different implants, viewed by parallel beams of x-rays. With the normal divergent beams small differences arise which are inappreciable to the eye but can be analyzed geometrically or, more conveniently, by a special "implant reconstructor."

SUMMARY

To summarize this somewhat disconnected survey of the possibilities of reducing the determination of tissue doses to a system of elementary computations, it may be claimed that for radium treatments a simple system, sufficiently accurate for clinical requirements, can be established. For x-ray treatments, with which may be grouped radium bomb therapy, satisfactory results can be achieved by the compilation of isodose charts in a special way, the only source of error of any importance being connected with special effects in skin. One essential feature stands out—that much closer collaboration between the physicist and the radiotherapist is called for. Simplicity in dosage cannot be achieved if the therapist uses his physical agents in any arbitrary manner, nor can the therapist tolerate restrictions on his technic so prescribed as to limit its utility to a few selected cases. Only by a careful consideration of the requirements of both specialists can a general scheme of treatment and dosage be built up, and not until such a system is available equally well to the smallest clinic as to the largest can we be said to have solved the problem of tissue dosage.

ALOE VERA IN THE TREATMENT OF RADIATION ULCERS OF MUCOUS MEMBRANES

By FREDERICK B. MANDEVILLE, M.D., Professor of Radiology, Medical College of Virginia, *Richmond, Virginia*

IN 1935, Collins and Collins (1) published a favorable report on the treatment of roentgen dermatitis with the fresh whole leaf of *Aloe vera*. Later that year Collins (2) added a report on the use of an ointment of *Aloe vera* (Alvagel) as a therapeutic agent for roentgen and radium burns. The following year Wright (5) gave a paper on the use of *Aloe vera* in the treatment of roentgen ulcers and telangiectasis. He concluded that (5):

"From the cases reported it would seem that x-ray ulceration, even of several years' duration, will respond to the use of *Aloe vera*. The permanence of the results can be determined only by watching cases thus treated over a period of time. Little can be expected in the treatment of telangiectasis as a result of irradiation beyond the smoothing and softening of the affected skin."

Probably the most recent and authoritative information, worth quoting at length to bring it to the attention of radiologists, comes from MacKee, who says (3):

"During the past two or three years excellent results have been obtained with the jelly obtained from the leaf of a plant called *Aloe vera*. The plant grows in Florida. The leaf is green in color and long and wide—somewhat like a sword. The shell of the leaf is thick and tough, but when fresh can be cut easily with a knife. On one side of the leaf the shell is flat; on the other side it is convex. There is a thick layer of jelly-like substance between the shells. The leaf should be kept in a cool, moist environment. It is customary to cut a piece of the leaf to the size and shape of the lesion. The convex shell layer is removed. The jelly is placed in contact with the floor of the ulcer and held in place with a bandage. Dressings are changed once or twice daily. The treatment seems to be inefficacious for roentgen or radium sequelæ—atrophy, telangiectasia, sclerosis, and keratosis. It appears most effective in the case of indolent roentgen and radium ulcers. Often the pain disappears within a day or two and healing takes place in a few weeks or a few months—more often the latter. The writer can vouch for the good results in a fairly large percentage of indolent ulcers. Good results have been obtained also in ulcers that occur early in third-degree reactions.

"To obtain satisfactory results it seems necessary to use the fresh leaf. Preparations on the market which contain the *Aloe vera* jelly have been thus far unsatisfactory. It is thought that the good results are due to vitamin D."

Our own personal experience in man has been limited to five cases. All five have experienced definite relief from pain and discomfort, as mentioned by MacKee. One case of severe roentgen dermatitis of the face, treated two years ago with the fresh leaf, can be recorded as an excellent result. Three other cases of roentgen ulcers of the skin, in patients treated for carcinomas of the prostate, breast, and vagina, died incident to their disease, before a reasonably accurate or satisfactory evaluation of *Aloe vera* therapy could be made. Relief from pain was definite, sloughing appeared to clear more readily, and skin grafting was successful in the breast case.

As no cases of radiation ulcers of the mucous membranes treated with *Aloe vera* have been noted by us in the literature, our purpose is to report the fifth case which has remained well for two years following healing of osteo-radio-necrosis of the tongue, floor of mouth, and mandible.

Case 5. A 54-year-old white male had noticed a growth 1 cm. in diameter on the right side of his tongue and floor of his mouth anteriorly for three months. This was removed by a surgeon with electrocautery and the pathologic diagnosis by A. C. Broders, M.D., was squamous-cell epithelioma, Grade 3. There was slight enlargement of the anterior right cervical lymph nodes. He was then referred for radiologic treatment. Intra-oral radium therapy, heavily filtered, and external deep x-ray therapy was administered over a ten-day period. The case was complicated by ex-

tensive peri-odontal disease, which seemed to be a factor in the marked and severe radiation reaction of the tongue and mouth which began on the fourth day following the completion of therapy. The acute reaction began to subside within 14 days, but during the next three months a large ulcer of the right side of the tongue and floor of the mouth developed. All of the teeth were extracted, a few at a time, but osteo-radio-necrosis developed in the right mandible in spite of expert dental care and mouth hygiene. An alcohol injection of the third branch of the right fifth nerve was performed but the patient still suffered pain in the floor of the mouth and tongue. The ulcer was deep and measured 5 × 1.5 cm. and left the right mandible exposed. Films of the mandible showed rarefaction of the upper right margin about 5 centimeters in length and 0.5 centimeter in depth. Approximately three and one-half months following radiation therapy the jelly-like substance of fresh *Aloe vera* leaf was held by the patient within the mouth for from one and one-half to thirteen and one-half hours daily for a period of eight weeks, averaging seven hours daily. Relief from pain was prompt and definite and the ulcer slowly grew smaller. Saline mouth washes were used between and after this *Aloe vera* therapy. Five weeks later a single sequestrum of the upper right mandible was lifted off with forceps. In another five weeks the ulcer was completely healed. Removable dentures were fitted six months later. The mouth is dry and there is some furrowing of the tongue and limitation of its motion. The patient has been followed for two years since complete healing was obtained and has been seen in large radiologic clinics elsewhere, with no evidence of ulceration.

We believe that osteo-radio-necrosis should be prevented when possible, but as rather large numbers of such cases are being reported from the larger radiological centers where protection, filtration, and dosage are carefully considered, any means which will aid in its treatment should be described.

SUMMARY

1. Recent literature on *Aloe vera* therapy for radiation ulcers of the skin is briefly reviewed.

2. Radiation ulcers of the mucous membranes and adjacent tissues of body cavities may also be treated with the fresh leaf of *Aloe vera*.

3. A case of osteo-radio-necrosis of the mouth so treated and well two years following healing is briefly reported.

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THE DIAGNOSIS OF UNUSUAL CALCAREOUS SHADOWS FOUND ON X-RAY FILMS OF THE ABDOMEN[1]

By CASSIE BELLE ROSE, M.D., *Boulder, Colorado*

IN the years from 1922 to 1936, inclusive, almost thirty thousand films of the abdomen were taken in the x-ray department of the Presbyterian Hospital of Chicago. Unusual calcareous shadows found in this series of films, with their problems in differential diagnosis, form the basis of this report.

Each of these patients was studied in close co-operation with the attending physician by means of the clinical history and physical findings, as well as appropriate laboratory work, including thorough x-ray examinations. Most of them were further observed either at operation or autopsy. Without such close co-operation in the study of these cases, the diagnosis would often have been impossible.

Radiologists know that in the upper abdomen the most common calcareous shadows found by x-ray are kidney stones, with gallstones a close second. In the lower abdomen and pelvis those most frequently found are ureteral and bladder stones, phleboliths, calcified glands, and occasionally calcified fibroids in the female or prostatic calculi in the male. Other types of calcareous shadows occur infrequently. One must always be on guard for the unusual form or location of common shadows. In addition, there may be peculiar, rare, or atypical calcareous shadows which require, for diagnosis, every help possible, and may even then be in doubt.

The first three cases are unusual forms of common shadows found in the lower abdomen, and are reported because of the extraordinary size of each lesion.

CASE REPORTS

Case 1. The first case is that of a large, sharply defined, uniformly dense shadow lying within the bony pelvis and simulating the cystogram of a moderately large bladder. Knowing that this is a male patient, which rules out calcified fibroid, and that there had been no injection of opaque material before taking the film, the x-ray diagnosis of an extremely large bladder stone is made. On cystoscopic examination this stone was visible and so large that the cystoscope could not be introduced more than an inch into the bladder.

Case 2. The next film shows two large calcareous masses, 7 × 5 and 7 × 10 cm., lying within the bony pelvis. Three or four smaller ones are also present. At first glance these shadows suggest two enormous bladder stones and several small ones. However, since the patient is a woman and these shadows are not close together, their outline is somewhat irregular, and they are not solid in their density, an x-ray diagnosis of multiple areas of calcification in fibroids is suggested rather than multiple bladder stones.

The pelvic examination revealed a hard, nodular mass the size of a large grapefruit lying in the hollow of the sacrum. It extended from the right to the left of the pelvic wall and almost as high as the symphysis pubis. The mass was not tender and did not compress the rectum. Therefore, the clinical and x-ray diagnosis coincided.

Ureteral and bladder stones sometimes occur in the same patient and usually both produce characteristic symptoms.

Case 3. The film of the next patient, a man 64 years of age, shows a concentric ringed dense shadow in the bladder region measuring 3 × 4 cm. (Fig. 1-*A*). Another shadow, sausage-shaped and hooked at its lower end, overlies the left sacro-iliac joint. It measures 3 × 8.5 cm. Its shape and position, in spite of its enormous size, suggest a ureteral stone.

On cystoscopic examination, only the

[1] Presented before the Fifth International Congress of Radiology, Chicago, Sept. 13–17, 1937.

bladder stone was visible: the other shadow could not be made out. A ureteral catheter could be passed only an inch into this ureter, and pyelogram solution could be injected no farther. (This case was studied in 1923, before the advent of intravenous pyelography.)

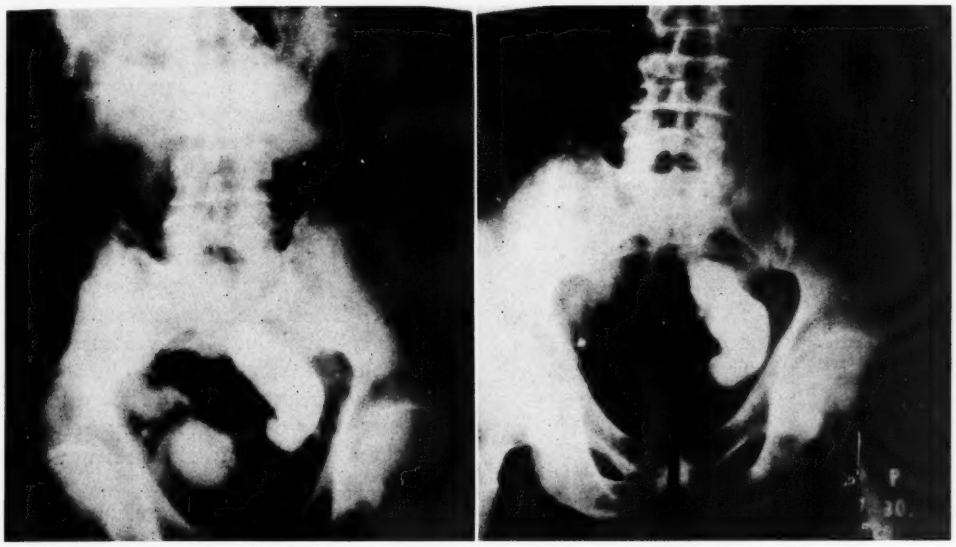

Fig. 1-*A*. Fig. 1-*B*.

Fig. 1-*A*. Case 3. Film shows bladder stone and large low-lying ureteral stone. Both removed at operation. Patient's age, 64 years.

Fig. 1-*B*. The large ureteral stone recurred after ten years, and has persisted to date. Patient now is 78 years old.

The patient's symptoms pointed to a bladder stone—there was no indication of a ureteral stone. The bladder stone was removed through a suprapubic incision, and the other large stone seen by x-ray was removed through a longitudinal incision in the left ureter.

Ten years later this patient returned. To our surprise a similar stone, again symptomless, had recurred in the same ureter (Fig. 1-*B*). This stone has persisted to date. The patient, who is now 78 years of age, says that he is perfectly well and he certainly looks the picture of health.

In contrast to the foregoing cases, the next film presents small multiple shadows of a type rarely seen.

Case 4. This patient's film shows multiple small ring shadows arranged like a string of beads and following a rather tortuous course transversely across the midpart of the bony pelvis. Never having seen this type of calcification, we made no x-ray diagnosis at that time. Soon afterward another patient was x-rayed to show an injection of lipiodol into the ejaculatory duct. Since this film resembled that of the previous case, we were able to make a diagnosis of the first case as calcification along the course of the ejaculatory duct and seminal vesicles.[2]

The shadows on the next film, while not strictly within the abdomen, are so striking as to warrant inclusion in this paper.

Case 5. The film shows many streaks and spots of dense material extending from the midpart of each ilium downward and outward to the upper part of the thigh. Once recognized, they are unmistakable. They are due to multiple hypodermic in-

[2] This case is reported in full by Norris J. Heckel, in Am. Jour. Roentgenol. and Rad. Ther., **39**, 377, 378, March, 1938.

jections of opaque material into the buttocks. The shape of the shadow is determined by the technic of injection—a round spot if the needle is held still and a streak if the needle is being withdrawn during the injection. In the present drive against syphilis in this country, it is quite likely that many such cases will come to light in the future.

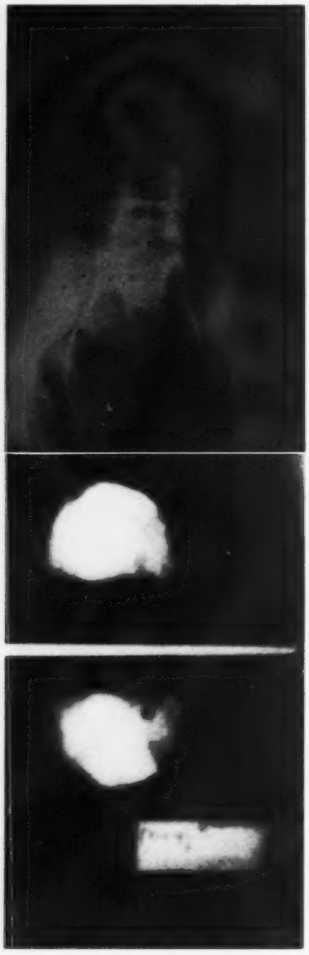

Fig. 2-*A* (*above*). Case 6. Oval densely calcified shadow, 5 × 7 cm., in left kidney region.
Fig. 2-*B* (*below*). Film of specimen which, after postmortem study, was diagnosed as an "extra-peritoneal peri-renal osteoma."

All radiologists have seen small oval and large deer-horn kidney stones but a large oval shadow such as is shown in the next case is rare in the kidney area.

Case 6. On this film a very large, oval, densely calcified shadow is visible in the left kidney region on the anteroposterior view (Fig. 2-*A*). On lateral view it is over the second lumbar vertebra. Its position is, therefore, characteristic of kidney stone. It is of unusual size, measuring 5 × 7 cm., and in its upper portion there is a somewhat less dense area. The retrograde pyelogram shows a small normal kidney pelvis near the lower margin of this density and the rest of the pyelogram is not visible. The same is true with the intravenous pyelogram. The fluoroscopic examination shows this mass to be outside of the stomach and colon. The x-ray diagnosis was a rare type of kidney stone. The patient's death resulted from a ruptured diverticulum and peritonitis.

The postmortem examination revealed "a regular, oval, very firm mass posterior to the left kidney and loosely attached to the capsule of the kidney by threads of fibrous tissue." It suggested a dermoid to the pathologist. Microscopic studies showed "this mass to be only bone. The Haversian canals had multiple directions with no symmetry of arrangement of all." It was then diagnosed as an extra-peritoneal, perirenal osteoma.[3] A film of the postmortem specimen is here shown (Fig. 2-*B*).

Shadows which at first suggest one type of lesion may, on further study, prove to be of an entirely different type.

Case 7. The postero-anterior film of this patient shows in the right upper quadrant a well-defined, closely packed, globular group of a hundred or more small stones which surely suggest gallstones (Fig. 3-*A*). However, on the anteroposterior view (Fig. 3-*B*) the stones string out for the length of three vertebræ, and three small groups of stones project laterally from the upper end of the large mass. On the lateral view the stones are grouped rather

[3] This case is reported in full by Dr. H. L. Kretschmer in Surg., Gynec. and Obst., **67**, 108–113, July, 1938.

closely and overlie the second and third lumbar vertebræ as do kidney stones, instead of anterior to the spine in the gall-

over the ilium suggested a dermoid containing bone. We were not prepared for the findings at operation.

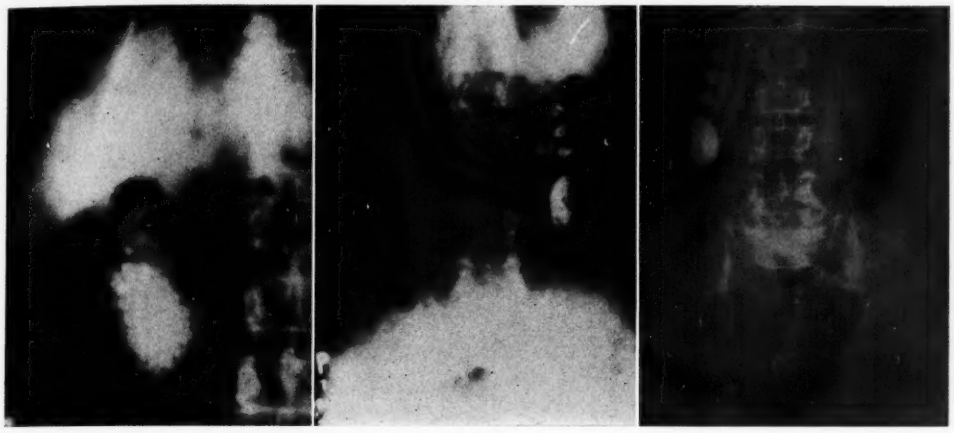

Fig. 3-*A*. Fig. 3-*B*. Fig. 3-*C*.

Fig. 3-*A*. Case 7. Postero-anterior film shows a hundred or more small closely packed stones suggesting gallstones.

Fig. 3-*B*. The antero-posterior view shows these stones strung out for the length of three vertebræ, with three small groups projecting laterally from the upper end of the larger mass.

Fig. 3-*C*. Film shows that the pyelogram increases the density in the area of the stones and spreads them apart slightly. Therefore, these shadows are in reality due to kidney stones.

bladder position. A pyelogram (Fig. 3-*C*) increases the density in the area of the stones and spreads them slightly apart. Furthermore, a cholecystogram shows a normal gall-bladder filling. A colon fluoroscopy shows the densities to be outside of the bowel. Hence a group of a hundred or more small stones which, at first glance seemed typical of gallstones, proved on further x-ray study to be kidney stones of most extraordinary number and grouping.

Occasionally kidney stones lie in a most unusual position.

Case 8. On this patient's film several irregular bonelike densities resembling phalanges overlie the left ilium. The left kidney outline is visible in its normal position and contains a little calcareous débris. The ureteral catheter passes mesial to the shadows over the left ilium. The ureter and one major calyx are fairly well visualized by the pyelographic solution. The other calices are not visible.

The kidney findings seemed to indicate tuberculous calcification, and the shadows

This patient came to the hospital because of a red tender area, which seemed to be an abscess, pointing in the region of the left groin. This abscess, when incised, opened into a large fibrous-walled cavity which extended to the kidney. From the bottom of this cavity several stones were obtained. These accounted for the shadows over the left ilium.

The course of events in this patient was then clear. An abscessed kidney had perforated and gravitated downward carrying with it multiple kidney stones. The kidney itself remained in its normal position and contained a small amount of sand.

Calcification in the spleen is comparatively rare.

Case 9. Occasionally, as with this patient, there is found in the spleen area a group of tiny, round, sharply circumscribed, uniformly dense shadows, often from fifty to a hundred or more. Such shadows arise from two causes: first, from multiple phleboliths in the spleen substance (which are of no particular clinical

significance) and, second, from small calcified tuberculous nodules in the spleen capsule which are comparatively rare. It is

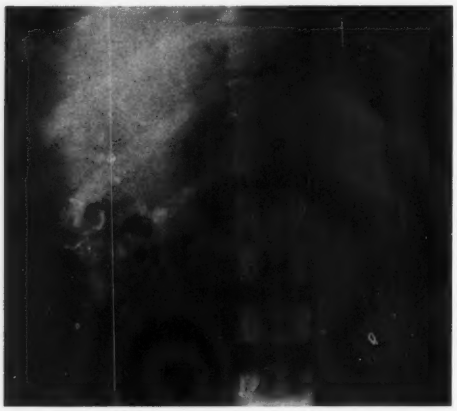

Fig. 4. Case 12. Film shows the slightly mottled and the ring type of shadows due to multiple calcified echinococcus cysts in the liver.

noteworthy that tuberculous nodules which are not calcified show as areas of slightly lessened density on films of the spleen taken after its removal from the body.

Occasionally, one finds a ring shadow suggesting a gallstone except that it is on the left side. Such shadows may be explained as incomplete or partial calcification of the splenic artery. Marked calcification is shown on the films of the next two cases.

Case 10. This patient's film shows a tortuous double line of density in the left upper abdomen a little above the kidney and somewhat mesial to the spleen. It has the appearance of a calcified artery, which, from its position, is probably the splenic artery.

Shortly after this film was taken, the patient, a man 85 years of age, died from myocardial hypertrophy and degeneration due to coronary disease. The postmortem showed marked generalized arteriosclerosis, including the splenic artery. Even the arterioles of the spleen were considerably thickened.

Case 11. A few months later, the films of another male patient, 60 years of age, showed an even more marked calcification of the splenic artery with associated gallstones. In this film the position and tortuosity of the splenic artery are clearly visible.

Tumors of many types may contain deposits of calcium either within or about the periphery of a degenerated or cystic area. Several examples follow.

Calcification of echinococcus cysts is sometimes shown on x-ray films. If present, this calcification is circular in outline. Sometimes there is a mottled or even a nearly solid density within the ring. There may be one or many such shadows. They occur in the liver and, it is said, sometimes in the spleen. If the cysts are not calcified, the x-ray film may reveal only an enlarged liver, which offers no differential criteria between echinococcus cysts and other types of liver enlargement. It is helpful to note the patient's nationality, usually Greek or Italian, although he may have lived many years away from his native land.

Case 12. The case here presented shows many characteristic shadows on the x-ray film (Fig. 4) which are sufficient for diagnosis of an echinococcus cyst and to differentiate from gallstone colic, which the symptoms so closely resemble. At operation 1,200 c.c. of pus was aspirated by means of a trocar. Then the liver was incised and there escaped from the right lobe a huge number of cysts varying in size from pinheads up to three inches in diameter. Several of these showed granular deposits on their outer surface, undoubtedly accounting for the shadows shown on the x-ray film.

Calcification is a frequent response in the healing of tuberculous lesions, such as a tuberculous kidney, mesenteric gland, or a psoas abscess. Such calcification is shown by x-ray examination as a mottled or "mulberry" type of shadow. A ring type of calcification is uncommon.

Case 13. In one patient, however, the x-ray film shows oval ring shadows lying close to the spine from the second to the fifth lumbar vertebræ; three on the left

side and one on the right (Fig. 5-*A*). The largest is the size of a hen's egg; the smallest about half that size. In addition, the the ring shadows along the spine are due to calcification in multiple psoas abscesses or in tuberculous glands.

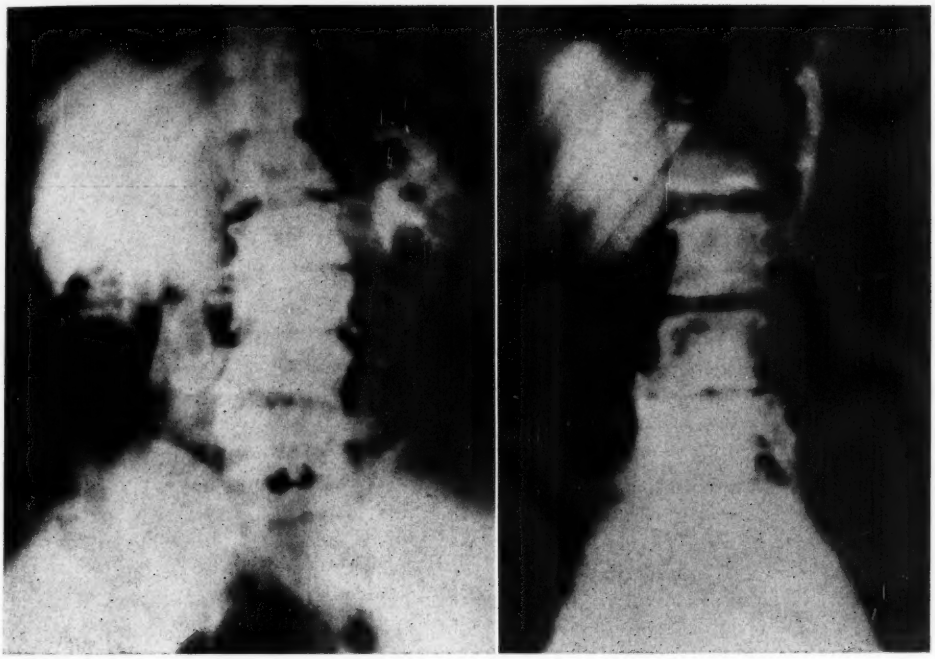

Fig. 5-*A*. Fig. 5-*B*.

Fig. 5-*A*. Case 13. Film shows four oval ring shadows, three to the left and one to the right of lumbar spine, the largest is the size of a hen's egg. Third and fourth lumbar vertebræ are narrowed and irregular, with narrow interspace. Diagnosis is tuberculous spine with calcified multiple psoas abcesses.

Fig. 5-*B*. Lateral view of the same tuberculous spine. The calcified ring shadows are hidden by the vertebræ.

third and fourth lumbar vertebræ are narrowed and irregular along their intervertebral margins. The interspace is distinctly narrowed. Some calcification, with bridging, is present (Fig. 5-*B*) along the anterior and lateral margins of these vertebræ. The abdomen is otherwise normal. Intravenous pyelograms are normal except that the ureters are pushed out slightly in the region of these oval shadows. A chest film shows definite evidence of old, bilateral, partly calcified, upper lobe tuberculosis.

Nine years previously the patient had had a left mid-thigh amputation for tuberculosis of the knee joint and upper end of the tibia. With this history and the above x-ray evidence it seems certain that

Most uterine fibroids lie in the lower abdomen, and if calcified, their shadows are shown within the bony pelvis on x-ray films. However, calcification in very large fibroids may be shown by x-ray examination in any part of the abdomen, even under the costal arch. Therefore, such shadows may at times be confused with other types of calcification within the abdomen. It is most helpful in differentiation to note whether or not a soft-tissue tumor extends from within the bony pelvis upward high enough to contain the shadow in question. Very large fibroids simulate a pregnant uterus near term, except that fetal parts are not visible.

Other large abdominal tumors, such as

an ovarian or mesenteric cyst, cause similar soft-tissue shadows. However, they seldom contain calcification and rarely extend downward into the bony pelvis.

Case 14. In the uterine fibroid here was removed which contained multiple areas of degeneration, several of which were calcified, corresponding to those seen on the x-ray film. A film taken after operation shows none of the calcified areas. The

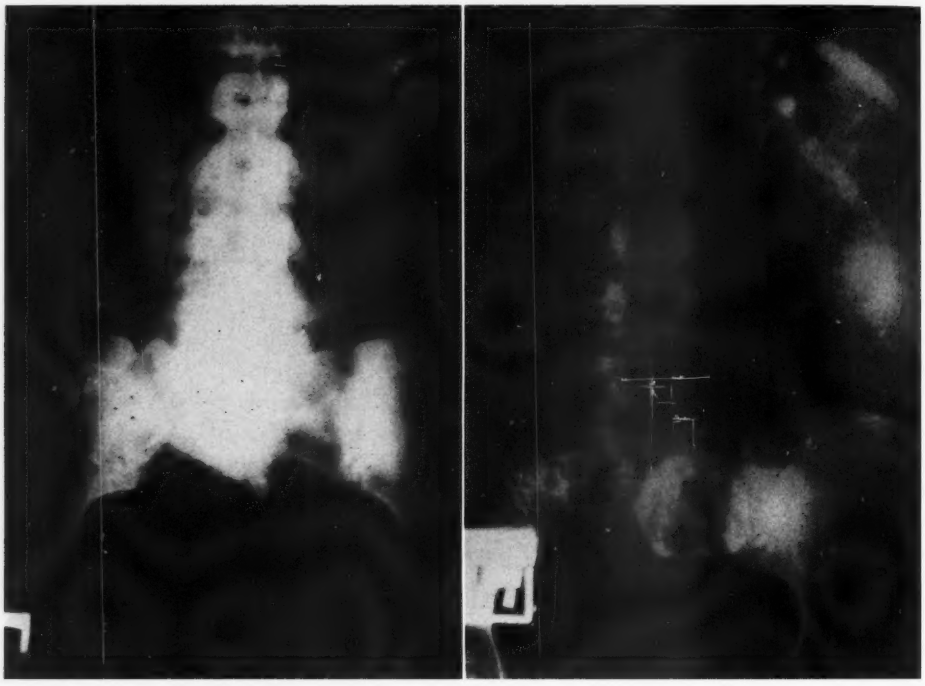

Fig. 6-*A*. Fig. 6-*B*.

Fig. 6-*A*. Case 14. Uterine fibroid containing two large rings of calcification and several smaller ones extending up to the costal arch.

Fig. 6-*B*. Case 15. Uterine fibroid with many small areas of calcification extending up to the ribs, and two large oval areas of calcification over the sacrum.

presented, the plain film shows a soft-tissue shadow which almost fills the abdomen and pelvis and pushes the colon to either side, as shown by the position of its gas content (Fig. 6-*A*). Within the tumor are three areas of irregularly mottled calcification and two oval shadows. One oval shadow measures 3.5 × 5 cm. and lies to the right of the third and fourth lumbar; the other measures 5 × 6.5 cm. and overlies the right sacro-iliac region. The mottled areas of calcification are scattered in the abdomen and one is under the costal arch. The intravenous pyelogram is normal.

At operation a very large fibroid tumor general abdominal density is normal and the gas in the bowel has returned to its normal location.

Case 15. This female patient had a very definite psychosis. Her x-ray film shows a whorled and mottled type of calcification extending over most of the abdomen, but still within the outline of a very large soft-tissue tumor (Fig. 6-*B*). At operation a huge fibroid uterus was removed which contained multiple areas of degeneration with calcification, corresponding to the shadows seen on the x-ray film. It is interesting to note that the patient's psychosis cleared at once. On the film taken

after operation the previous shadows have disappeared.

Calcareous ring shadows may be associated with degenerated areas in tumors other than fibroids. Hypernephroma of the kidney is an example. This first came to my attention in 1921.

Case 16. On this patient's film an oval shadow with fairly dense periphery and slightly mottled interior is visible in the lower part of a large right kidney. At operation the kidney was found to be about 9 × 15 cm. in size, with a tumor involving the entire kidney and invading the surrounding structures. On cut section the kidney revealed a soft, mushy, degenerated mass which could be scooped out with the hand. Within this mass was one area about six centimeters in diameter surrounded by a capsule of old clotted blood and some fibrous tissue which contained a little calcification. Microscopically the tumor was definitely a hypernephroma.

In 1924, I saw a similar case in Vienna which was confirmed at postmortem. I saw a third case, in 1935, in the Presbyterian Hospital in Chicago.

Case 17. This patient's film shows a ring of calcification about five centimeters in diameter over and slightly above the left ilium. It extends to the lower margin of a rather large kidney outline. The pyelogram is bizarre and definitely deformed. The ring shadow lies just below the inferior calyx. A colon fluoroscopy shows that the enlarged kidney and the ring shadow lie posterior to the descending colon and are not attached to it. On physical examination there was slight tenderness in the left lower quadrant and two masses could be felt in the left side of the abdomen, one of which was apparently connected with the lower pole of the left kidney, the other slightly lower, each about the size of a hen's egg and respiratory mobile.

The diagnosis was a kidney tumor with calcification, lying either in the lower pole of the kidney or attached to it. The patient was 86 years of age, therefore, operation was considered inadvisable and x-ray therapy was given. This reduced the size of the tumor slightly and controlled the patient's pain fairly well until he died from pneumonia a year later. An autopsy was not permitted. It was believed, however, that this tumor was a hypernephroma.

The last case to be presented is unique, and is valuable for study because it so closely simulated a Wilms' tumor.

Case 18. The anteroposterior film of this patient, a boy five years of age, shows an enormous soft-tissue tumor which distends the upper abdomen, especially to the right, so much that the ribs are displaced outward. Two small areas of calcification are visible within the tumor—one near the midline of the abdomen, the other just below and near the tip of the last right rib. The lateral view shows that the tumor bulges the abdomen forward but does not extend down into the bony pelvis, its lower margin being at the level of the sacrum. The calcareous shadows are again visualized, the smaller one being near the anterior periphery of the tumor, the other in the mid-abdomen. A line of air, representing bowel, is pushed back close to the spine, posteriorly. The lumbar vertebræ are normal.

The mass was distinctly palpable and gave the impression of a large kidney tumor. The patient was very sick and except for the aspiration of 1,400 c.c. of muddy-colored fluid from the abdomen, no further work could be done, and he died three days after entering the hospital.

Imagine our astonishment when the postmortem revealed one unmistakable fetus, 9 cm. long, of undetermined sex but having arms, legs, three rudimentary toes on each deformed foot, and no head but a tuft of light brown hair at the usual location of the neck. In addition, there was another mass 4 cm. in diameter, resembling a testis with an attached penis 3 cm. long. These were contained in a large sac, 20 cm. in diameter, filled with a gray-green turbid fluid, which was found lying beneath the transverse mesocolon, and apparently attached to the gastrohepatic ligament.

The pathologist felt that this tumor represented a multiple pregnancy in which one child, born at term, was host to cell inclusions which later developed fetal characteristics, thus producing this unnatural and perverted multiple pregnancy in a male child.

CONCLUSION

As consulting radiologists, let us remember that unusual cases, such as have been presented, can be differentiated from more common lesions and correctly diagnosed only by a most careful consideration of all the evidence obtainable, not only from x-ray examination, but also from the clinical history, and physical findings. Therefore, it is imperative for us to work in close cooperation with the clinician, the surgeon, and the pathologist.

717 9th St.

CASE REPORT

RADIOGRAPHY OF THE PAROTID DUCT

By LESTER W. PAUL, M.D., Associate Professor of Radiology, University of Wisconsin Medical School, *Madison, Wisconsin*

Roentgen visualization of the parotid gland and its duct, free from overlying bony shadows, is, ordinarily, a difficult technical procedure. Since the majority of such examinations are done for the detection of stones, the presence of overlying bony shadows is a distinct handicap and conducive to diagnostic errors. If the jaws, especially the upper, are edentulous, less trouble is encountered, since it usually is the shadow of the upper teeth which interferes in lateral or oblique views. The majority of calculi are found in the ducts of the salivary glands rather than in the substance of the glands themselves. The method to be described allows clear visualization of Stensen's duct without any confusing bony or tooth shadows.

The gross anatomic features of the parotid gland and its duct are shown in Figure 1, taken from Sobotta and McMurrich's Atlas. On the surface, the course of the duct corresponds to the middle third of a line drawn from the lower edge of the external auditory meatus to a point halfway between the base of the nose and the vermillion edge of the upper lip.

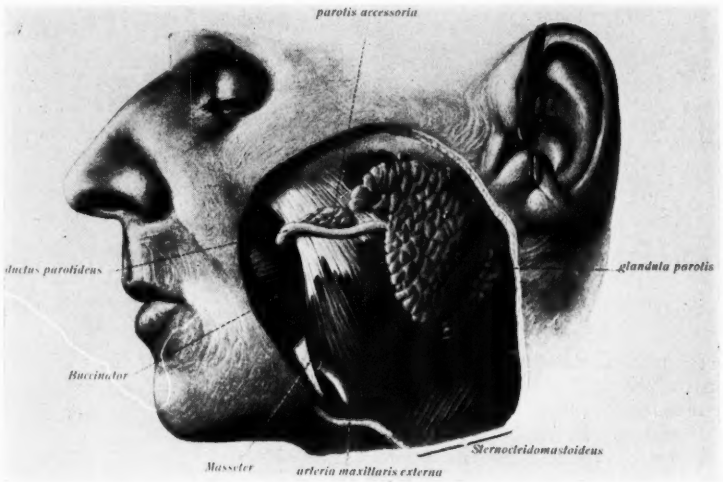

Fig. 1.

An ordinary intra-oral occlusal type of film is used and positioned as shown in Figure 2, with the occlusal plane of the upper jaw parallel to the floor. The central ray is directed downward at an angle of approximately 60 degrees and forward about 20 degrees. The point of center on the cheek is slightly posterior, and above a point corresponding to the middle third of the duct. The technical factors are those which would be satisfactory for the

Fig. 2.

upper bicuspid teeth. In positioning the film within the mouth it is necessary to bend it so that the outer surface is convex. The central ray is then perpendicular to the film at the height of the convexity and since this corresponds to the area of the duct no significant distortion is produced. It is necessary to insert the film firmly against the anterior pillar of the tonsil and if gagging is troublesome, cocainization of the pharynx is recommended, although this will seldom be needed. The resulting radiographs are illustrated in Figures 3 and 4. Figure 3 is a radiograph made after the injection of lipiodol into the duct. Figure 4 shows a calculus impacted in the mid-portion of the duct. This stone shadow, even though large, was missed in radiographic examination at another clinic and a diagnosis of tumor was made.

Fig. 3.

Fig. 4.

For visualization of the region of the gland proper, the view ordinarily used to show the ramus and coronoid process of the mandible is recommended. Because of the close relationship of the gland to the ramus it is impossible to visualize it entirely without the shadow of the ramus overlying a portion of it. With proper exposure factors and stereoscopic films, a sufficiently clear view will be obtained. This view is recommended, particularly when a study of the gland is to be made after lipiodol injection.

WHO SHALL PRACTISE MEDICINE?

Not the least important problem confronting the profession of radiology to-day is the question of the status and domain of the lay technician in radiological practice. It is a question which arises again and again, in one phase or another, as the Inter-Society Committee approaches professional and socio-economic situations in various sections of the country. It is a question which urgently demands solution.

A recent article by Albert A. Rayle, M.D., a portion of which is reprinted herewith by permission of the *Journal of the Medical Association of Georgia*, states the problem in clear fashion. In connection with Dr. Rayle's straight-forward comments, it is interesting to compare an article in a similar vein written more than ten years ago by the present Chairman of the Inter-Society Committee for Radiology, Arthur C. Christie, M.D.

Lest some misunderstanding occur, it may be well to define the term "lay technician" before quoting from the two papers mentioned above. Certainly neither the Inter-Society Committee, nor any individual radiologist, has anything less than the highest esteem and appreciation for the invaluable services of the technician whom he employs and upon whose conscientious loyalty and skill he depends for assistance in the practice of his profession. The function of these individuals fills an indispensable ancillary rôle in the practice of radiology.

But, when the lay technician attempts the practice of radiology upon his own part, without the supervision of a licensed physician-radiologist, he or she becomes a quack, proposing to render a service for which the individual is unqualified, untrained, and incompetent. He becomes a "limited practitioner" and like other cultists, he professes to possess special ability in a particular field without having gone to the trouble and expense of equipping himself with the essential medical background.

The question of the non-medical practitioner of radiology is one which threatens the very survival of a recognized and important specialty in medicine. The evil has been fostered by numerous modern developments in the practice of medicine, such as the industrial clinic where a lay technician examines and reports on cases treated under workmen's compensation laws, and the attempts to divide the specialty into technical and professional phases under group hospitalization plans. If these situations are to be corrected, and if further unsound tendencies are to be forestalled, radiological practitioners themselves must point the way. If radiology is, as we contend, a clinical specialty demanding medical training instead of a technical laboratory procedure to be performed by laymen, then radiologists must demonstrate to their medical colleagues that such is the case.

It is somewhat paradoxical that the article published by Dr. Christie when he was editor of the *American Journal of Roentgenology and Radium Therapy*, in 1927, contains some answers to the questions posed by Dr. Rayle in his article written twelve years later. If this be irony, it simply goes to show that there remains much room for progress in the solution of a vexing problem.

From Dr. Rayle's paper, presented before a meeting of the Fulton County Medical Society, Atlanta, we quote as follows:

"There is an old feeling, still ingrained in the make-up of a physician, that he should devote his thoughts to the scientific phases of his work and let the economic phases take care of themselves. Perhaps this is the reason physicians are reputedly poor business men. But now the economic phases have thrust themselves on us and we have to talk about them, however distasteful it may be.

"We physicians have nothing to sell but our services. We have spent many years and many thousands of dollars to make those services worth something to the public—and we are entitled to sell them in fair market, without improper restrictions or unfair competition.

"Therefore we are all interested in what we call 'socialized medicine,' which, for our purposes, we will define as any system whereby either the professional or economic aspects of practice are controlled by laymen. The two go hand in hand, for economic control will lead to professional control. It is axiomatic that the man who pays the fiddler eventually will call the tune.

"For most of you, socialized medicine is something to talk about at medical meetings. For us in radiology it has arrived in one form or another. What I shall say will be primarily about radiology, but it applies also to other fields, and it is only a matter of time until it will concern every one of you.

"Realizing the dangers surrounding radiology from an economic standpoint, the four national societies have organized the Inter-Society Committee for Radiology, whose sole purpose is to deal with matters affecting the economics of radiologic practice. This Committee has asked and obtained the support of the Georgia Radiological Society, which at its last meeting appointed a committee to deal with the subject for which I speak tonight.

"The Georgia committee decided to limit its field to four topics. Of these, our first two problems are in process of adjustment and need not concern us in this discussion.

"Our third problem, the lay-radiologist, may be stated as a formula. (1) Radiology is the practice of medicine; (2) Medicine legally may be practised only by those physicians holding a license. (3) But laymen practise radiology. It does not come out even, or make sense. Why? Because certain members of the medical profession support and defend the lay-radiologist. Why? Because the lay-radiologist can and does offer inducements which medical men cannot ethically offer. You may ask why we do not hail the lay-radiologist to court. The reason is that if we do, he can and will employ a cheap doctor to go in partnership with him and sign his reports. As long as there are doctors who will do this, we can accomplish nothing.

"Suppose we set up a hypothetical situation equally as logical. I believe any one of you will agree that any bright young man with a reasonable amount of training could learn to take out tonsils, appendices, gall bladders, and uteri in an acceptable manner from a standpoint of surgical technic. Well then, why not train up a lot of laymen as surgical technicians? Obviously, you would say, 'Such a man would have no medical background. He might know how to take out an appendix but he would not know when.' Now that is just exactly the objection we offer to the lay-radiologist. He may be an excellent technician, he may have picked up a working knowledge of x-ray diagnosis, but he certainly cannot have acquired a medical background.

"But suppose we carry out the surgical technician idea a bit farther. Say we have these trained surgical technicians. The internist might say, 'Well, this is great. I can make a diagnosis. I know when to operate. These fellows know how to operate. We will work together. I will send my patient to the surgical technician. He will operate for a few dollars a case. Why should I let the surgeon milk the cream from my patients?' Why, my friends, if any such system as this were seriously proposed, surgeons would be wringing their hands from Maine to California. And yet some surgeons support the same set-up in radiology."

From Dr. Christie's editorial, published under an identical title in the *American Journal of Roentgenology and Radium Therapy*, **18**, 464, we quote the following:

"It is well known that there is a widespread and probably growing tendency to depend upon lay technicians, not only for the technical work which is their proper field, but for opinions on the roentgen findings, and even for diagnosis of the underlying pathological process. The medical profession itself is largely to blame for the development of this abuse just as it has been responsible by neglect of certain fields for the success of most of the medical cults. Roentgenologists themselves must bear at least a part of the blame for the assumption of medical functions by the technician. It is true that many roentgenologists take a very serious view of their responsibilities as medical consultants and follow the general practice of seeing every patient referred to them for roentgen-ray diagnosis, and their final opinion is based not only upon the roentgen-ray findings but upon a knowledge of the history of the case and all other information available.

"But on the other hand, there are many who base their entire report upon the roentgen findings alone, perhaps even upon films alone, never having seen the patient and having no knowledge whatever of the previous history, the course of the disease, nor the patient's present condition. There are, of course, situations in which the above course is not censurable, where the final results are to be evaluated by a well-trained internist who is capable of giving all information its due weight. Even in such instances, however, it is probable that better results are achieved by close co-operation and consultation between the internist and the roentgenologist than can be obtained by the roentgenologist's submitting a report based upon roentgenologic examination alone. It is a fact that in many offices and hospitals

the only person who really sees the patient who is referred for roentgen examination is the roentgen technician, and in many such places the technician's opinion is the only one sought.

"It is, therefore, not to be wondered at that the general physician who refers patients to roentgenologists for examination gradually comes to depend upon the technician for his findings rather than upon the doctor and that he finally adopts the practice of sending his patients to a commercial roentgen-ray laboratory or depends upon the report of a lay technician in a hospital. Only a little reflection, however, will show that such practice is not in line with general medical progress and that it carries actual and potential dangers of great importance. At the present time all over this country the roentgen ray is being used for diagnosis and treatment of disease not only by variously trained lay technicians but by the practitioners of almost all of the medical cults whether or not they are licensed to practise medicine. In recent times it is reported that even 'beauty parlors' have used the roentgen ray extensively for the removal of superfluous hair.

"The cure for the 'technician evil' lies entirely within the medical profession. It will undoubtedly persist so long as there is a considerable number of physicians who do not realize that there is a wide gap between the films produced by the technician and their translation into terms of underlying pathology. The cure of the evil will be in sight when physicians realize that they are fostering another class of irregular, ignorant, unlicensed medical practitioners who are already rendering reports of roentgen-ray findings directly to patients and in some instances even using the roentgen ray as a therapeutic agent. In the meantime, the roentgenologist who takes a high view of his obligations would do well to review his own attitude and practice in the employment of technicians."

MAC F. CAHAL,
Executive Secretary

RADIOLOGICAL SOCIETIES IN THE UNITED STATES

Editor's Note.—Will secretaries of societies please cooperate with the Editor by supplying him with information for this section? Please send such information to Leon J. Menville, M.D., 1201 Maison Blanche Bldg., New Orleans, La.

CALIFORNIA

California Medical Association, Section on Radiology.—Chairman, Karl M. Bonoff, M.D., 1930 Wilshire Blvd., Los Angeles; *Secretary,* Carl D. Benninghoven, M.D., 95 S. El Camino Real, San Mateo.

Los Angeles County Medical Association, Radiological Section.—President, E. N. Liljedahl, M.D., 1322 North Vermont Ave., Los Angeles; *Vice-president,* M. L. Pindell, M.D., 678 South Ferris Ave.; *Secretary,* Wilbur Bailey, M.D., 2007 Wilshire Blvd.; *Treasurer,* Henry Snure, M.D., 1414 South Hope Street. Meets every second Wednesday of each month at County Society Building.

Pacific Roentgen Club.—Chairman, Lyell C. Kinney, M.D., San Diego; *Secretary,* L. Henry Garland, M.D., 450 Sutter Street, San Francisco. Executive Committee meets quarterly; Club meets annually during annual session of the California Medical Association.

San Francisco Radiological Society.—Secretary, L. H. Garland, M.D., 450 Sutter Street. Meets monthly on first Monday at 7:45 P.M., alternately at Toland Hall and Lane Hall.

COLORADO

Denver Radiological Club.—President, F. B. Stephenson, 452 Metropolitan Bldg.; *Vice-president,* K. D. A. Allen, M.D., 452 Metropolitan Bldg.; *Secretary,* E. A. Schmidt, M.D., 4200 E. Ninth Ave.; *Treasurer,* H. P. Brandenburg, M.D., 155 Metropolitan Bldg. Meets third Tuesday of each month at homes of members.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Chairman, Ralph T. Ogden, M.D., 179 Allyn St., Hartford; *Secretary-Treasurer,* Max Climan, M.D., 242 Trumbull St., Hartford. Meetings twice annually in May and September.

DELAWARE

Affiliated with Philadelphia Roentgen Ray Society.

FLORIDA

Florida Radiological Society.—President, H. O. Brown, M.D., 404 First National Bank Bldg., Tampa; *Vice-president,* H. B. McEuen, M.D., 126 W. Adams St., Jacksonville; *Secretary-Treasurer,* J. H. Lucinian, M.D., 168 S. E. 1st St., Miami.

GEORGIA

Georgia Radiological Society.—President, James J. Clark, M.D., Doctors Bldg., Atlanta; *Vice-president,* L. P. Holmes, M.D., University Hospital, Augusta; *Secretary-Treasurer,* Robert C. Pendergrass, M.D., Prather Clinic, Americus. Meetings twice annually, in November and at the annual meeting of the Medical Association of Georgia in the spring.

ILLINOIS

Chicago Roentgen Society.—President, David S. Beilin, M.D., 411 Garfield Ave.; *Vice-president,* Chester J. Challenger, M.D., 3117 Logan Blvd.; *Secretary-Treasurer,* Roe J. Maier, M.D., 7752 Halsted St. Meets second Thursday of each month, September to May, except December.

Illinois Radiological Society.—President, Cesare Gianturco, M.D., 602 W. University Ave., Urbana; *Vice-president,* Fred H. Decker, M.D., 802 Peoria Life Bldg., Peoria; *Secretary-Treasurer,* Edmund P. Halley, M.D., 968 Citizens Bldg., Decatur. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—The next meeting will be May 2, 3, 4, 1939, to be held in Rockford. The officers of the Section for the coming meeting are Harry B. Magee, M.D., of Peoria, *Chairman,* and Warren W. Furey, M.D., 6844 Oglesby Ave., Chicago, *Secretary.*

INDIANA

Indiana Roentgen Society.—President, Stanley Clark, M.D., 108 N. Main St., South Bend; *President-elect,* Juan Rodriguez, M.D., 2903 Fairfield Ave., Fort Wayne; *Vice-president,* A. C. Holley, M.D., Attica; *Secretary-Treasurer,* Clifford C. Taylor, M.D., 23 E. Ohio St., Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

MAINE

See New England Roentgen Ray Society.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Chairman, Whitmer B. Firor, M.D., 1100 N. Charles St.; *Secretary,* Walter L. Kilby, M.D., 101 W. Read St. Meetings third Tuesday of each month.

MASSACHUSETTS

See New England Roentgen Ray Society.

MICHIGAN

Detroit X-ray and Radium Society.—President, Sam W. Donaldson, M.D., 326 N. Ingalls St., Ann Arbor; *Vice-president,* Clarence Hufford, M.D., 421 Michi-

gan Ave., Toledo, Ohio; *Secretary-Treasurer*, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave.

Michigan Association of Roentgenologists.—President, E. R. Witwer, M.D., Harper Hospital, Detroit; *Vice-president*, D. W. Patterson, M.D., 622 Huron Street, Port Huron; *Secretary-Treasurer*, C. K. Hasley, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—President, Leo G. Rigler, M.D., University Hospital, Minneapolis; *Vice-president*, Harry M. Weber, M.D., Mayo Clinic, Rochester; *Secretary*, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. These officers will assume their duties after the Summer meeting which will be held in connection with the Minnesota State Medical Society, May 31 to June 2, 1939.

MISSOURI

The Kansas City Radiological Society.—President, L. G. Allen, M.D., 907 N. 7th St., Kansas City, Mo.; *Secretary*, Ira H. Lockwood, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—President, Paul C. Schnoebelen, M.D.; *Secretary*, W. K. Mueller, M.D., University Club Bldg. Meets on fourth Wednesday of October, January, March, and May, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—President, T. T. Harris, M.D., Clarkson Memorial Hospital, Omaha; *Secretary*, D. Arnold Dowell, M.D., 117 S. 17th St., Omaha. Meetings first Wednesday of each month at 6 P.M. in Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY

(Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island.) *President*, Frank E. Wheatley, M.D., 520 Beacon St., Boston; *Secretary*, E. C. Vogt, M.D., 300 Longwood Ave., Boston. Meetings third Friday of each month from October to May, inclusive, usually at Boston Medical Library.

NEW HAMPSHIRE

See New England Roentgen Ray Society.

NEW JERSEY

Radiological Society of New Jersey.—President, Milton Friedman, M.D., 31 Lincoln Park, Newark; *Vice-president*, P. S. Avery, M.D., 546 Central Ave., Bound Brook; *Secretary*, W. James Marquis, M.D., 198 Clinton Ave., Newark; *Treasurer*, James Boyes, M.D., 744 Watchung Ave., Plainfield. Meetings at Atlantic City at time of State Medical Society, and Midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—President, Henry A. Barrett, M.D., 140 East 54th St., New York City; *President-elect*, I. J. Landsman, M.D., 910 Grand Concourse, New York City; *Vice-president*, Frederic E. Elliott, M.D., 122 76th St., Brooklyn; *Treasurer*, Solomon Fineman, M.D., 133 East 58th St., New York City; *Secretary*, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—President, Albert Voltz, M.D., 115–120 Myrtle Avenue, Richmond Hill; *Vice-president*, A. L. L. Bell, M.D., Long Island College Hospital, Henry, Pacific, and Amity Sts., Brooklyn; *Secretary-Treasurer*, E. Mendelson, M.D., 132 Parkside Ave., Brooklyn. Meetings first Tuesday in each month at place designated by president.

Buffalo Radiological Society.—President, Walter Mattick, M.D., 101 High St.; *Vice-president*, Chester Moses, M.D., 333 Linwood Ave.; *Secretary-Treasurer*, J. S. Gian-Franceschi, M.D., 610 Niagara Street. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen-ray Society.—President, W. E. Achilles, M.D., 60 Seneca St., Geneva; *Vice-president*, M. T. Powers, M.D., 250 Genesee St., Utica; *Secretary-Treasurer*, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings held in January, May, and October as called by Executive Committee.

Long Island Radiological Society.—President, Samuel G. Schenck, M.D., Brooklyn; *Vice-president*, G. Henry Koiransky, M.D., Long Island City; *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn; *Treasurer*, Louis Goldfarb, M.D., 608 Ocean Ave., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—President, Raymond W. Lewis, M.D., 321 E. 42nd St., New York City; *Vice-president*, Henry K. Taylor, M.D., 667 Madison Ave., New York City; *Secretary*, Roy D. Duckworth, M.D., 170 Maple Ave., White Plains; *Treasurer*, Eric J. Ryan, M.D., St. Luke's Hospital, New York City; *Member of Executive Committee*, E. Forrest Merrill, M.D., 30 W. 59th St., New York City. Meetings third Monday evening each month at Academy of Medicine.

Rochester Roentgen-ray Society.—Chairman, Joseph H. Green, M.D., 277 Alexander St.; *Secretary*, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—President, Robert P. Noble, M.D., 127 W. Hargett St., Raleigh; *Vice-president*, A. L. Daughtridge, M.D., 144 Coast

Line St., Rocky Mount; *Secretary-Treasurer*, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meetings with State meeting in May, and meeting in October.

OHIO

Cleveland Radiological Society.—President, John Heberding, M.D., St. Elizabeth's Hospital, Youngstown; *Vice-president*, R. V. May, M.D., St. Luke's Hospital, Cleveland; *Secretary-Treasurer*, Harry Hauser, M.D., City Hospital, Cleveland. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive

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Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*President*, B. M. Warne, M.D., Doctors Building, Cincinnati: *Secretary-Treasurer*, Justin E. McCarthy, M.D., 707 Race St., Cincinnati, Ohio. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—President, Charles S. Caldwell, M.D., 520 S. Aiken Ave., Pittsburgh; *First Vice-president*, Thomas L. Smyth, M.D., 111 N. 8th St., Allentown; *Second Vice-president*, Reuben G. Alley, M.D., Western Pennsylvania Hospital, Pittsburgh; *Secretary-Treasurer*, Lloyd E. Wurster, M.D., 416 Pine St., Williamsport; *President-elect*, Louis A. Milkman, M.D., 212 Medical Arts Bldg., Scranton; *Editor*, William E. Reiley, M.D., Clearfield. Annual meeting, June 2 and 3, 1939, Bedford Springs Hotel, Bedford, Penna.

Philadelphia Roentgen Ray Society.—President, Thomas P. Laughery, M.D., Germantown Hospital; *Vice-president*, Elwood E. Downs, M.D., Jeans Hospital, Fox Chase; *Secretary*, Barton H. Young, M.D., Temple University Hospital; *Treasurer*, R. Manges Smith, M.D., Jefferson Hospital. Meetings first Thursday of each month from October to May, Thompson Hall, College of Physicians, 19 S. 22nd St., 8:15 P.M.

The Pittsburgh Roentgen Society.—President, William B. Ray, M.D., 320 E. North Avenue, N. S. Pittsburgh; *Secretary*, Harold W. Jacox, M.D., 4800 Friendship Ave. Meetings held second Wednesday of each month at 4:30 P.M., from October to June at various hospitals designated by program committee.

RHODE ISLAND

See New England Roentgen Ray Society.

SOUTH CAROLINA

South Carolina X-ray Society.—President, Percy D. Hay, Jr., M.D., McLeod Infirmary, Florence; *Secretary-Treasurer*, Hillyer Rudisill, Jr., M.D., Roper Hospital, Charleston. Meetings in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association

SOUTH DAKOTA

Meets with Minnesota Radiological Society.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee State Radiological Society.—President, S. S. Marchbanks, M.D., 508 Medical Arts Bldg., Chattanooga; *Vice-president*, Steve W. Coley, M.D., Methodist Hospital, Memphis; *Secretary-Treasurer*, Franklin B. Bogart, M.D., 311 Medical Arts Bldg., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—President, Jerome H. Smith, M.D., San Antonio; *President-elect*, C. F. Crain, M.D., Corpus Christi; *First Vice-president*, M. H. Glover, M.D., Wichita Falls; *Second Vice-president*, G. D. Carlson, M.D., Dallas; *Secretary-Treasurer*, Henry C. Harrell, M.D., 517 Pine St., Texarkana. Meets annually. Temple is place of next meeting.

VERMONT

See New England Roentgen Ray Society.

VIRGINIA

Radiological Society of Virginia.—President, Fred M. Hodges, M.D., 100 W. Franklin St., Richmond; *Vice-president*, L. F. Magruder, M.D., Raleigh and College Aves., Norfolk; *Secretary*, V. W. Archer, M.D., University of Virginia Hospital, Charlottesville.

WASHINGTON

Washington State Radiological Society.—President, H. E. Nichols, M.D., Stimson Bldg., Seattle; *Secretary*, T. T. Dawson, M.D., Fourth and Pike Bldg., Seattle. Meetings fourth Monday of each month at College Club.

WISCONSIN

Milwaukee Roentgen Ray Society.—President, H. W. Hefke, M.D.; *Vice-president*, Frederick C. Christensen, M.D.; *Secretary-Treasurer*, Irving I. Cowan, M.D., Mount Sinai Hospital, Milwaukee. Meets monthly on first Friday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russel F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor* HOWARD P. DOUB, M.D., *Associate Editor*

PARTNERSHIPS OF RADIOLOGISTS[1]

A SEQUEL TO "THE RADIOLOGIST AND THE HOSPITAL," 1934 YEAR BOOK OF RADIOLOGY

At a meeting of Eastern Radiologists, in Washington, in 1934, I spoke to you on the subject of "The Radiologist and the Hospital" using the hospital relationships of Drs. Groover, Christie, and Merritt as a text. At the request of the editors, this plan of radiological practice was published in the 1934 Year Book of Radiology. We have been surprised and gratified at the interest manifested in it. By way of a progress report, let me say that our hospital relationships have remained practically unchanged during the intervening five years, and so far as I know there are no ominous clouds on the horizon to threaten their continuance. We are still of the opinion that *under suitable conditions* the plan outlined and practised by us for the past twenty years is the best yet devised from the standpoint of the medical profession, the hospital, and the public.

It has occurred to me that you might be equally interested in our partnership relations, inasmuch as they have an important if not indispensable bearing on the hospital plan above referred to.

Two of our group joined forces in 1916. Others have been added from time to time until there are now eight members of the partnership. The average age of the partners is 49 years. I think that 45 years would be about the optimum average age for a group such as ours. We have made it a rule never to take anyone into the partnership until they have practised radiology for at least five years. We have this rule to enable us to appraise more accurately a prospective partner's qualifications. In choosing a partner, one should have in mind the fact that a partner is not easily discarded.

We have another rule which precludes equal partnership until one has practised radiology at least fifteen years. This may seem arbitrary but it has sound actuarial basis. A radiologist is more likely to reach the peak of his earning capacity after fifteen years of practice than he is before. You might find it interesting to check that statement against your own experience.

At the present time we have no physician employee in our organization unless you choose to regard as employees three Fellows in Radiology, each having a two-year term of service. We consider it risky to continue a physician employee indefinitely on a salary basis when you do not consider him eligible for partnership responsibilities and do not intend to offer him membership in the organization. Under such circumstances the question of exploitation is apt sooner or later to arise.

Our non-professional personnel consists of 16 technicians and 13 clerks. Our entire group, therefore, comprises 40 individuals as shown in the following table:

Physicians (partners)	8
Physicians (fellows)	3
Technicians	16
Clerks	13
Total	40

These are distributed in four units, three of which are in hospitals. We have found it desirable to have one of the more mature radiologists and one of the younger ones teamed together at each place. A physician referring patients to a specialist or other consultant is more than apt to choose one of

[1] Read at the meeting of the Eastern Radiologists, at Washington, D. C., Feb. 10, 1939.

his contemporaries. It may have been this fact rather than one of relative fitness and capability that prompted Sir William Osler's suggestion that physicians over sixty may as well be chloroformed.

and their exact appraisal and proper observance a prime essential. Without them you never know where you are or the direction you are facing. Without at least one in the organization who has a flair for that sort of thing, the

	For the year 1939	For the year 1940	For the year 1941	For the year 1942	For the year 1943
1.	.15747	.15394	.15045	.14583	.14416
2.	.15747	.15394	.15045	.14583	.14416
3.	.15747	.15394	.15045	.14583	.14416
4.	.15747	.15394	.15045	.14583	.14416
5.	.15747	.15394	.15045	.14583	.14416
6.	.11765	.1253	.13275	.14583	.14416
7.	.05	.055	.06	.065	.07
8.	.045	.05	.055	.06	.065
	1.00000	1.00000	1.00000	.99998	.99996

	For the year 1944	For the year 1945	For the year 1946	For the year 1947	For the year 1948
1.	.14166	.13833	.135	.13166	.12714
2.	.14166	.13833	.135	.13166	.12714
3.	.14166	.13833	.135	.13166	.12714
4.	.14166	.13833	.135	.13166	.12714
5.	.14166	.13833	.135	.13166	.12714
6.	.14166	.13833	.135	.13166	.12714
7.	.08	.09	.10	.11	.12714
8.	.07	.08	.09	.10	.11
	.99996	.99998	1.000	.99996	.99998

Shifting of personnel from one unit to another is avoided as far as may be practical. The routine operation of each unit is largely autonomous. Nevertheless, it is essential that a certain uniformity of policy and practice be maintained, and there are, in reality, many things that an individual of the group would not do without the approval of the group. A certain amount of red tape, or good manners if you prefer the term, is essential to the harmonious operation of any group. For instance, one partner should never purchase new equipment or make commitments as to employment or salaries of personnel without the approval of the other partners.

Formal business meetings are held on the first and sixteenth of each month, and special business meetings are occasionally held to thresh out important problems which may arise. Minutes of these meetings are carefully scrutinized and preserved.

Semi-formal clinical conferences are held twice monthly during the winter months. No studied attempt is made to standardize strictly professional practices, but actually these clinical meetings and other informal discussions promote a degree of uniformity.

In the operation of a joint enterprise such as ours, I consider accurate business records

chances of the success or permanence of the organization will be greatly lessened.

Naturally, the first item for consideration in the above connection will be the partnership agreement. The parties to such an agreement should realize that contingencies may arise which it is impossible for them to foresee. If this happens, they should, if possible, settle the matter at issue by mutual agreement rather than by an appeal to the courts. Nevertheless, the partnership agreement should be legal and with that end in view we have from time to time sought legal counsel. Indeed, if one does not understand something of the laws relating to partnership he may quite unexpectedly find himself in the middle of an embarrassing situation.

There are two main parts to a partnership agreement. First, it must set forth the participating interest of the respective partners. In instances in which this is equal and unchanging, this is a simple matter. Where it is unequal and constantly changing, as it has been with us, it is more complex. At the beginning of this year we took into the partnership two of the younger men who had completed their five-year apprenticeship and it was, of course, necessary to amend our partnership agreement. The table on this page shows the

participating interest of the partners, as amended.

A second part of a partnership agreement concerns itself with the settlement of a partner's interest in the event of his separation from the partnership, by death or otherwise. Unless this is specifically and clearly provided for, it is more than apt to become a subject of controversy. This provision must needs be governed by other circumstances connected with the business of the partnership. The joint ownership of property would of course modify the terms of settlement, as would also the debts of the partnership. Our own agreement, as it now stands, provides that the remaining partners shall pay to the retiring partner, or to his estate in case of death, an amount equal to that received by him from the business during the two calendar years immediately preceding his retirement or demise.

You will at once see that this places on the partnership a very real obligation and responsibility which should, and I hope does, impose upon us the necessity of conducting our affairs with a view to its complete fulfillment. It is a matter that requires constant watching and re-appraisement, otherwise our agreement will in the end turn out to be "just another scrap of paper."

I will set down a few of the things which ordinary prudence should prompt us to do and not to do.

(1) We should maintain a cash reserve equal to about 10 per cent of our gross annual income.

(2) We should carry insurance on the lives of all the partners in an amount equivalent to at least two-thirds of the estimated liability under the partnership agreement.

(3) The partnership should not borrow money.

(4) Over - expansion of the partnership should be guarded against.

Disregard of any one of these four items enumerated might make it an onerous task to meet the terms of the partnership agreement and disregard of two or more might make it impossible.

We have one qualifying clause in our agreement which we think is unique. It is as follows: "In the event any partner is absent from the partnership business for any cause other than sickness or physical disability, for any period in excess of 30 days during any twelve-month period, a proportionate deduction for such excess time shall be charged against his partnership interest for such twelve-month period, the deduction on account of such excess absence to be made from the amount to be paid to him or to his representative as of the time of his separation from the partnership by death, retirement, or otherwise."

There are, of course, other qualifying clauses in our agreement, one of which allows the remaining partners a certain amount of latitude as to the time they may take in settling a retiring partner's interest. To be legal, an instrument of this sort is also presumed to be reasonable.

Inasmuch as none of the partners in our organization has as yet retired or died, what I have said in that connection is not based on personal experience.

As I have previously intimated, adequate and accurate accounting is the best barometer of our business, as indeed it is of any business. Two of our employees devote their entire time to that end of it, and a few facts gleaned from the record may interest you.

Seventy per cent of our gross income is derived from diagnostic and 30 per cent from therapeutic radiology. It is our opinion that more than 50 per cent of our professional time and effort and 50 per cent of our overhead is devoted to the latter branch. This means that it requires two and one-third doctors to earn a dollar doing therapy as compared to one doctor doing diagnostic work. If our experience in this regard is indicative of a general trend throughout the country, as I suspect it is, it might very well lead radiology into economic difficulties that would seriously impair its status as a specialty. Illustrative of what I mean, I do not recall having heard a radiologist read a paper on fractures for many years; very little on the subject appears in radiological literature; and I doubt if many of us, particularly the younger men, take serious interest in it or fully realize that it has been, and still is, from a financial standpoint, the top cream of radiological practice. By way of contrast, I would say that the radiological treatment of cancer, from a financial standpoint, is well-diluted skimmed milk. I realize, of course, that you can cite a few exceptions to the latter statement but these do not invalidate it as applied to the entire radiological picture.

I have not said the foregoing with the idea that we should necessarily take less interest in therapeutic radiology, but that we should take more interest in the ordinary garden variety of diagnostic problem, including technical de-

tails, which can be fully as difficult and interesting and far more profitable. With respect to technic, for instance, I no longer feel capable of directing it in all of its details and have long felt the need of a chief technician whose responsibility would be to keep our technical work well above the ordinary. I have, on occasion, attended meetings of our national radiological societies, and having a desire to see some superlative technical work, would be chagrined to find it necessary to visit the manufacturers' exhibits in order to do so.

In other words, I am suggesting that if we take the rich top soil of diagnostic roentgenology and use it in a questionable effort to enrich the comparatively barren soil of therapeutic radiology, the entire radiological field is apt to show progressively diminishing profits. I am inclined to think that profits and progress on the whole follow a parallel course and if I am correct in this it would mean that radiological standards would automatically sink to a lower level. I feel perfectly justified, therefore, in warning radiologists not to permit themselves to take a complacent attitude toward the alleged simpler problems of diagnosis. If he gives them the scrupulous attention they deserve he can, to a large extent, prevent their expropriation by other groups of practitioners. In this connection, I am reminded of the biblical character who was appointed to guard an important prisoner. The prisoner escaped, and when the guard was brought to task about it his only defense was that while he "was busy here and there the prisoner was gone." The radiologist's bread and butter practice will likewise vanish if he is too busy "here and there" to guard it properly.

From 1925 to 1937, inclusive, an average of 53 per cent of our gross receipts has gone into the doctor's pocket. Please note that this does not represent the profit of the partnership, because during all of that time some of the doctors were on a salary. This yearly analysis is made primarily with a view to maintaining a proper balance between overhead and professional income regardless of whether the latter was distributed as salary or on a percentage basis. During the 13 years covered by this survey, the highest percentage of the gross income accruing to the benefit of the doctors in any one year was 56 per cent and the lowest, 47 per cent. In actual practice, of course, the relationship of overhead to profits tends automatically to remain fairly steady, but unless the various items of income and overhead are broken down and analyzed over a considerable period of time, proper adjustment is merely a matter of luck.

I have already indicated that, so far as we are concerned, we ought to pay more attention to the diagnostic end of our business. For accounting purposes, our expenditures are broken down into approximately thirty different items. I will not bore you by discussing all of these. Approximately two-thirds of our overhead or one-third of our gross income is spent for the following items:

Salaries of clerks and technicians	.16
Rent	.10
Photo and darkroom supplies	.07
Total per cent of gross income	.33

Two of the hospitals with which we are connected furnish, and of course own, the permanent equipment of the x-ray department and this figures in the item of rent in the above table. The radiologist is not in a position to deal intelligently with such variations without a comprehensive knowledge of all of the related facts. He must particularly keep in mind that his business is subject to slumps the same as other businesses and that it will be he who will have to pay the penalty for unwise commitments made in prosperous times. With the steadily increasing overhead costs of practising scientific medicine, it becomes increasingly important for the physician to understand and be guided by sound business practices.

I am sure that many partnerships of physicians are foredoomed to disappointment because they are founded on delusive objectives. Many are founded with the hope that it will enable the participants to make more money and make it easier. This may or may not happen—it is largely a gambling proposition. Another delusive objective is that by forming a partnership you will restrict competition. Actually, your partner is just as much of a competitor as if he had an independent office next door. Another delusive objective is that it will increase volume capacity. Actually, volume capacity per man power is more than apt to be decreased.

The best objective for a partnership, and the one least likely to have a sting of disappointment to it, is that it will enable the participants to do better work. Any other advantage which may accrue should be looked upon as a by-product of the more efficient service they

will be able to render because of the facilities afforded for consultations and conferences, which will in turn tend to compensate and correct each other's deficiencies. Assuming that the group is of high caliber, this will attract a more remunerative clientele and this is the only reason for assuming that group practice has any financial advantage over individual practice. The caliber of the medical group and the caliber of its clientele will automatically find a common level. This is one of several flies in the ointment of the medical co-operative of which we hear so much to-day. A high-class group cannot be made up of mediocre individuals. This fact fits the layman just as much as it does the doctor and no amount of hokus pokus can circumvent it.

Obviously, no hard and fast rules for selecting partners can be laid down, but if the intended implications from what I have said are kept in mind, mistakes are less likely to occur. Talents peculiar to individual members of the group should balance deficiencies of individual members. I use the term "talents" in an inclusive sense. For instance, unpopularity is capable of making one a misfit in almost any group.

I have already indicated that from a strictly economic standpoint our group is overbalanced on the side of therapy. Radiologists cannot continuously provide out of their earnings the subsidy which efficient radiotherapy of cancer requires.

I would never advise anyone with a marked reluctance to take a chance to go into a radiological partnership. To a considerable extent, it is a sporting proposition and one without a liberal streak of the gambling instinct in his make-up had better stick to solitaire. One who has a liking for teamwork is apt to find ample compensation for the restrictions which a partnership imposes. Indeed, most of the restrictions are for the individual's own good, however difficult it may be for him to accept them. Speaking for myself, my partnership relations have been quite satisfactory. I think that my associates feel the same way, and I trust that this circumstance may counterbalance the hazards and objections to radiological partnerships, which I have tried to emphasize.

THOMAS A. GROOVER, M.D.

ANNOUNCEMENT

THE TWELFTH GRADUATE FORTNIGHT OF THE NEW YORK ACADEMY OF MEDICINE

The Twelfth Graduate Fortnight of the New York Academy of Medicine will be held from October 23 to November 3, 1939.

The subject of this year's Fortnight is The Endocrine Glands and Their Disorders. The purpose of the Fortnight is to make a complete study and authoritative presentation of a subject of outstanding importance in the practice of medicine and surgery.

The Fortnight will present a carefully integrated program which will include clinics and clinical demonstrations at many of the hospitals of New York City, evening addresses, and appropriate exhibits. The evening sessions at the Academy will be addressed by recognized authorities in their special fields, drawn from leading medical centers of the United States. The comprehensive exhibit will include books and roentgenographs, pathological and research material, and clinical and laboratory diagnostic and therapeutic methods. It is also planned to provide demonstrations of exhibits.

The subject of the Fortnight will include the following: Historical sketch of the development of endocrinology; physiology of anterior lobe of pituitary gland; hyper- and hypopituitarism; pituitary diencephalic syndromes; physiology of the ovaries; physiology of testes and therapeutic application of male sex hormones; puberty, menstruation, and menopause; pregnancy; therapeutic application of female sex hormones; physiology of the parathyroid; hypo- and hyperparathyroidism; the adrenal cortex; the Cushing Syndrome—neoplasms of adrenal and their clinical relations; overfunction of the adrenal cortex; the adrenal medulla; adrenal insufficiency; relation of diabetes to endocrine system; relationship of endocrines to nervous system; the physiology and principal inter-relations of the thyroid; hyperthyroidism and hypothyroidism; surgical treatment of hyperthyroidism and other diseases of the thyroid gland.

The New York Academy of Medicine provides this program for the fundamental purpose of medical education. Consequently all members of the medical profession are eligible for registration. A complete program and

registration blank may be secured by addressing Dr. Mahlon Ashford, New York Academy of Medicine, 2 East 103 Street, New York City.

COMMUNICATIONS

MINNESOTA RADIOLOGICAL SOCIETY

The program of the Spring Meeting of this Society was so interesting and so largely attended that it seems well worth while to give it to our readers. It began at two o'clock, was interrupted at six-thirty by an informal dinner, after which two addresses were given. The program follows:

Roentgen Kymographic Studies in Cardiac Physiology. Ancel Keys, Ph.D., and H. S. Friedell, M.D., Minneapolis.

A Series of Interesting Duodenal Lesions. H. M. Weber, M.D., and C. Allen Good, Jr., M.D., Rochester.

Bone Atrophy: Report of an Unusual Case. C. P. Truog, M.D., and R. E. Buirge, M.D., Minneapolis.

The Practice of Radiology in Sweden. H. M. Berg, M.D., Bismarck, N. D.

Symposium on Radiation Therapy of Neoplasm of Stomach: Report and Analysis of Cases. C. N. Borman, M.D., A. U. Desjardins, M.D., C. O. Hanson, M.D., R. W. Morse, M.D., Edward Schons, M.D., and K. W. Stenstrom, Ph.D.

Medical Experiences in China. John L. McKelvey, M.D., University of Minnesota.

Observations on Roentgenology in Europe. H. M. Weber, M.D., Rochester.

GEORGIA RADIOLOGICAL SOCIETY

The Georgia Radiological Society held its Fall Meeting at the Macon Hospital, Macon, Georgia, on Dec. 13, 1938. Twenty members were present. The program consisted of: (1) a short business session; (2) a diagnostic round table, during which films were presented and discussed; (3) a paper on "Timing in Radiation Therapy," by Hillyer Rudisill, Jr., M.D., Roper Hospital, Charleston, S. C., the guest speaker; (4) a symposium on x-ray therapy of the breast, conducted by Thomas Harrold, M.D., Macon, Ga. The Society was entertained at luncheon by C. L. Ridley, M.D., Superintendent of the Macon Hospital.

So much excellent material was presented at the diagnostic round table that it was voted to hold an interim meeting in March, 1939, to further discuss the unused material. The invitation of William F. Jenkins, M.D., of Columbus, Ga., and Col. C. A. Stammell, Ft. Benning, Ga., to act as joint hosts to this meeting was accepted.

IN MEMORIAM

ANTOINE BÉCLÈRE (1856–1939)

Men are born, men die, and the world goes on as if their brief existence had not even made a ripple in the current of eternity. For the majority of human beings life is a mere struggle for a more or less precarious existence, and their presence on earth does little more than move the decimal point in vital statistics. But from time to time a man is born who, because of superior physical and mental endowment, because of exceptional opportunities, or because of hard and intelligent labor, may influence his profession in his own country or in the entire world, may affect the trend of science, or may alter the course of history.

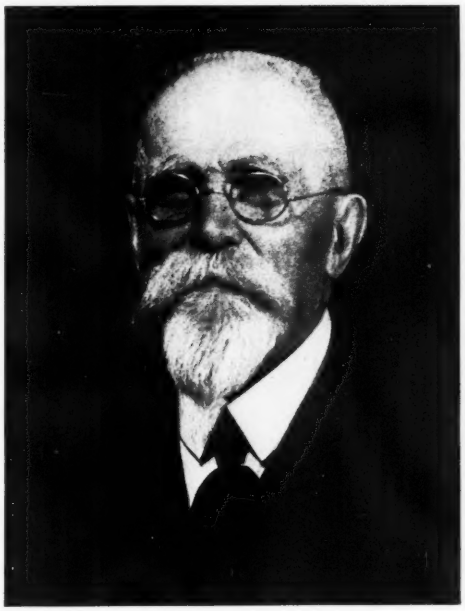
When, so recently, news of the death of Antoine Béclère was received, even the younger generation of radiologists outside of his native France, who barely knew his name, were affected because they saw the profound impression which this information produced on their seniors, most of whom well knew the tremendous influence which the work of Béclère has had on the development of medical radiology. His life can be cited as a well-nigh perfect example of the great and widespread effect which intelligent and persistent labor can have on the development of an art or science or on any form of human activity.

In France, where for so many years Béclère dominated the field of radiology, his death marks the passage of an epoch. In no other country, perhaps, has one man had such a predominating influence on a medical specialty as Béclère has had on French radiology. It was he who trained and inspired most of the present-day leaders in this field. Among the prominent exponents of radiology in France,

few are those who were not his pupils. Belot, Ledoux-Lebard, Maingot, Haret, and many others received from him their instruction in radiology and are now carrying forward the torch which he transmitted to them. During the active part of his career as a teacher, many radiologists from other countries of Europe and America went to Paris to take courses from Béclère or to observe the work constantly going on in his active service at Saint Antoine Hospital.

Although Béclère's reputation was based chiefly on his labors as a radiologist, those who are familiar with his long career are aware of the fact that, before turning his attention to radiology, he had already made his mark in experimental medicine and in children's diseases. It was perhaps this already broad experience, together with his keen intellect and mature judgment, which enabled him to proceed so surely and so effectively in applying to clinical medicine and surgery the remarkable rays discovered by Roentgen.

Born in Paris on March 17, 1856, he received his preliminary education at the Lycée Bonaparte (now the Lycée Condorcet). After some hesitation in the choice of a career, he finally selected medicine, and had as his principal teachers: Ollivier, Tillaux, Duplay, Lucas-Championnière, and Pinard. In 1875 his medical studies were interrupted by one year of military service, and in 1877 he began his service as an extern at Beaujon Hospital under Millard. His internship began in 1878, and he became greatly interested in dermatology, ophthalmology, and otology. The fourth year of his internship was spent with Labric, who was an excellent teacher of pediatrics. As a fertile field of study the contagious and epidemic diseases of children fascinated him, and as his thesis he selected "The Contagion of Measles," in which he proved that the disease can be transmitted at its very onset, that the danger of contagion is greatest during the period of oculo-nasal catarrh, and that the danger of contagion disappears with the rash. He also showed that contagion is easily neutralized by air, is quite ephemeral, and disappears spontaneously in a short time. These ideas which are now so well known, were then revolutionary. This thesis (1882) received no attention whatsoever but later Béclère's findings were confirmed and generally accepted. He also gave close attention to diphtheria and, after having performed 140 tracheotomies, was named monitor of tracheotomy. Having to serve as a substitute in the service of Brown-Séquard, he had an opportunity to learn much about the endocrine



The late Dr. Antoine Béclère

glands. He fed with sheep thyroid a patient suffering from myxedema, going each day to the slaughter house to obtain the glands. Thus, he was able to observe the danger of excessive thyroid feeding and described the signs of experimental hyperthyroidism provoked in this manner. He also tested the ingestion of fresh suprarenal gland from calves on Addison's disease.

Still intent on devoting his life to childhood diseases, and having some spare time between 1892 and 1900, he studied the analogies between cow-pox, small-pox, and syphilis from the standpoint of immunity and, in 1895, he was able to show that the serum of young cows which had been vaccinated had a considerable degree of immunity against cow-pox. He also investigated the immunizing power of serum from immunized human beings and animals against the virus of cow-pox. In 1899, he specified the conditions governing the intrauterine transmission of cow-pox immunity and demonstrated the anti-virulent power of human serum, and applied the results of his investiga

tions to the treatment of many victims of cow-pox. Moreover, his results were confirmed by others and soon became general knowledge.

In 1896, two friends, Doctors Barthélémy and Oudin, who were the first physicians in Paris to install apparatus to generate roentgen rays, invited their old professors to see the demonstration; only one, Professor Bouchard, came. Béclère, who had also been invited, could not arrive until the end of the demonstration. Nothing would do but his friends must re-examine with Roentgen's rays an old servant. Thus Béclère saw the shadow of the beating heart and aorta, the diaphragm rising and falling, and was astonished to find at the apex of one lung diminished clarity of the pulmonary tissue, possibly because of an old tuberculosis (years ago, this woman had had hemoptyses). He realized at once the great value of this new method of examination. Thenceforth, he devoted himself assiduously to the study of this new branch of medicine. Being familiar with geometry and physics, and having much clinical experience, he made rapid strides. During the very first year, 1896, he inaugurated a course in medical radiology, and for thirty years he gave this continually expanding course to thousands of French as well as foreign pupils.

His knowledge of ophthalmology made him realize at once that accommodation of the examiner's eyes to darkness was essential for a good roentgenoscopic examination, and he sought for years to make physicians in general understand this elementary fact.

In 1897, Béclère was transferred from Tenon Hospital to Saint Antoine Hospital, where he organized a primitive roentgenologic service and where he continued his course of instruction in radiology for physicians and medical students. Here also he devised many improvements in equipment which became standard: combined vertical and horizontal roentgenoscope; iris-diaphragm to control the beam of rays and increase the definition of the image, an incidence indicator; a roentgenoscopic table with the tube beneath the table to permit the examination of patients in the recumbent position; a plate-holding cassette which could be swung instantaneously in place of the fluorescent screen for rapid roentgenography; a spark-gap to measure rapidly in centimeters the length of the spark between two conductors and the use of this measurement as an indicator of voltage and indirectly of the quality or penetrating power of the rays.

At the outset, in France as in other countries, this new physical technic of examining patients was often taken up by physicists or technicians, and many short-sighted physicians thought it proper to leave roentgenologic procedures in their hands. Béclère vigorously and successfully opposed this tendency and made clear the many reasons why roentgenologic procedures, both diagnostic and therapeutic, must be confined to physicians.

In February, 1897, he published his first communication (with Oudin and Barthélémy) on "The Application of the Roentgen Method to the Examination of an Aneurysm of the Aortic Arch." In 1898, he presented a long report on "Roentgen Rays in the Diagnosis of Tuberculosis," and in 1899 he published a small book on the same subject. In 1900, he presented a communication on the "Diagnosis of Thoracic Diseases," and in 1901 he published a small book entitled "Roentgen Rays and the Diagnosis of Non-tuberculous Diseases of the Thorax." From 1900 he concentrated much attention and wrote extensively on the roentgenologic examination of thoracic and abdominal lesions, including diverticula of the esophagus and urinary calculi; in connection with the latter he advocated stereoscopic roentgenography. Another small book on "Roentgen Rays and the Diagnosis of Internal Diseases" appeared in 1904, and in the same year he contributed two important sections on fluorescent screens and roentgenoscopy and on the roentgenologic examination of the thorax and mediastinum and the diagnosis of thoracic and intrathoracic conditions for the exhaustive "Treatise on Medical Roentgenology" published under the direction of Professor Bouchard. In 1912 he prepared for the French Surgical Society a detailed review of the roentgenologic diagnosis of diseases of the digestive tract. Later he devoted a great deal of attention to the diagnosis of pituitary tumors as well as other brain tumors.

From the very beginning, also, Béclère interested himself in the therapeutic use of roentgen rays. As early as 1902 he called attention to the importance of precise methods of measurement in roentgen therapy. No sooner had Holzknecht, in 1900, presented the first instrument to measure the quantity of the rays, than Béclère went to Vienna to learn this new method. Subsequently, it was improved by Sabouraud and Noiré, who found that

pastilles of barium platino-cyanide were superior for the purpose. From 1904 to 1910 he treated many benign or malignant conditions of the skin, cancer of the breast, and, after Senn's announcement of the value of roentgen rays in the treatment of leukemia, he treated many cases of this disease, of Hodgkin's disease and lymphosarcoma, and closely observed the effect of the rays. In 1908, he began to treat uterine fibromyoma and, during the next twenty years, his extensive writings on the subject had a great influence on the entire medical profession. During the same period he treated tumors of the hypophysis, tumors of the testis, and many other varieties of neoplasm. Although he wrote a great deal, he never wrote hastily. Everything he wrote showed careful preparation of statistics, sound analysis, and conservative but firm conclusions. All his writings were characterized by clarity of thought and expression. His teaching also was marked by simplicity, great clarity, and order, and this is probably why Béclère had such an influence on radiology not only in France but throughout the world.

When the war of 1914 broke out, Béclère devoted all his attention to the teaching of roentgenology from the standpoint of its application to military medicine and surgery, and to questions of organization. Having been made director of all departments of radiology by the military government of Paris, he labored so hard and so effectively that, when the war ended, he had organized 120 such departments within the Paris area alone. Besides this task, he also had to train roentgenologists for the mobile hospitals and for the hospitals in the zone of the army. When the American army arrived in France, Béclère was able to render great assistance to many of our roentgenologists and to help to prepare them for the tasks which they would have to face.

Member of the Academy of Medicine (Paris) since 1908, he was elected President in 1928, and in the same year was selected as President of the Third International Congress of Radiology which was held in Paris in 1931. Then he turned his attention once more to the problem of immunity in syphilis and, after two years' work, he was able to achieve the experimental transmission of syphilis to the bovine species. Thus, at a time when most men seek peace and rest, Béclère's insatiable curiosity impelled him to continue to seek an answer to old or new problems, and these problems were not confined to the field of radiology.

Béclère's long and fruitful career is a shining example of what a man can do. He was not "brilliant" in any sense of the word. His achievements were reflections and natural results of the main qualities of his character: curiosity, a keen intellect, an enormous capacity for hard and steady work, tenacity and persistence, and sound judgment. Some might be tempted to add that he was fortunate in entering the field of medicine at a time when radiology was so soon to rise above the horizon, but, without his qualities of character, this circumstance could not have been an important factor.

In Béclère not only France but the world has lost a great radiologist and a great physician.

A. U. DESJARDINS, M.D.

BOYD E. WILKINSON, M.D.

Boyd E. Wilkinson, M.D., a member of the Radiological Society of North America since 1926, passed away at his home in Paterson, New Jersey, on April 11, 1939, after a heart attack. He was 58 years old.

Dr. Wilkinson, who was on the staffs of the Paterson General Hospital and the Good Samaritan Hospital of Suffern, N. Y., was born in Trevorton, Pa., on June 17, 1880, and attended schools there. He later attended Central Pennsylvania College, the Illinois Medical School in Chicago, and obtained his M.D. degree at Baltimore Medical College in 1905.

He was a captain in the medical corps during the World War and was chief roentgenologist in Evacuation Hospital 15 at Verdun. He moved to Paterson after the war and founded the radiological department at the General Hospital.

Surviving are his widow, Mrs. Louise Wilkinson; a son, Dr. Ralph, and a brother, Samuel, both of Trevorton.

Dr. Wilkinson's former associates extend their sympathy to the family he left.

HENRY SCHMITZ, M.D.

The Editor has received the sad news of the passing of Henry Schmitz, M.D., an honored member of the Radiological Society of North America.

A memorial sketch and portrait of Dr. Schmitz are being prepared for a forthcoming issue of RADIOLOGY.

BOOK REVIEWS

CLINICAL ROENTGENOLOGY OF THE DIGESTIVE TRACT. By MAURICE FELDMAN, M.D., Assistant Professor of Gastro-enterology, University of Maryland; Associate Roentgenologist, Sinai Hospital; Assistant in Gastro-enterology, Mercy Hospital, Baltimore, Maryland. A volume of 1014 pages, and 358 illustrations. Published by William Wood & Company, Baltimore, 1938. Price: $10.00.

This book is written especially as an aid for the roentgenologist, gastro-enterologist, student, and general practitioner who wishes to learn more about diagnostic roentgenology as applied to the digestive tract. Every phase of the gastro-intestinal tract is covered in a comprehensive and concise manner with the object of presenting the importance of the x-ray examination. The volume is chiefly a compilation of condensed facts and data that have been selected from the literature.

The text is arranged in 220 chapters, each of which contains the essential clinical, pathologic, and roentgenologic data relating to a particular subject. In some places the roentgenologic aspect, which is supposed to be the main theme of the text, is somewhat submerged by a mass of statistical data relating to various clinical phenomena. To the radiologist the general consideration accorded the technic of the roentgen examination and particularly that relating to the technic of fluoroscopy and palpation will seem somewhat brief, although this phase of the subject is amplified in the individual chapters as the occasion arises. A greater number of illustrations would enhance the value of the work for many readers.

On the whole, this is a most commendable text, written from the viewpoint of a clinician, that contains a wealth of information which is pertinent to the successful pursuit of an important specialty of medicine.

OH, DOCTOR! MY FEET! By DUDLEY J. MORTON, M.D., Associate Professor of Anatomy, College of Physicians and Surgeons, Columbia University. A volume of 111 pages, well illustrated by photographs. Published by D. Appleton-Century Company, New York and London, 1938. Price: $1.50.

This interesting and well illustrated book on static foot pain should be popular with the laity as well as the medical profession because of the clear and instructive manner in which it is written. There are only a few illustrations but they clearly show the importance of x-rays in the diagnosis and treatment of foot complaints. Upon completion of the book, one is convinced that he has been offered a very satisfactory explanation of the causes and treatment of flat, painful feet in association with and without anterior metatarsalgia. It is interesting to note that Dr. Morton points out the harmful effects of exercise in the presence of acute foot symptoms and its probable little effect in chronic pronated feet.

LE DIAGNOSTIC RADIOLOGIQUE DES TUMEURS MALIGNES DU PHARYNX ET DU LARYNX (The Radiologic Diagnosis of Malignant Tumors of the Pharynx and Larynx): ÉTUDE ANATOMO-TOPOGRAPHIQUE ET RADIOGRAPHIQUE (A Radiographic and Topographic-anatomical Study). By F. BACLESSE, Chief of the Service at the Curie Foundation, Radium Institute of the University of Paris. Preface by A. Hautant. A volume of 269 pages, and 236 illustrations. Published by Masson et Cie, Paris, France, 1938. Price: 100 fr.

This volume represents one of the finest presentations of any subject that it has been my pleasure to review. The subject matter is arranged in three general parts, as follows: (1) The Normal Pharynx and Larynx. (2) Malignant Tumors of the Pharynx. (3) Malignant Tumors of the Larynx. The normal radiographic anatomy is discussed in 46 pages and here numerous roentgenograms are correlated with diagrammatic sketches. Of particular interest is the chapter relating to ossification and calcification of the normal larynx. In the second part, relating to malignant tumors of the pharynx, the radiographic anatomy and the clinical and radiographic characteristics are given for each type of tumor. The findings in each group before and after radiotherapy are fully illustrated by roentgenograms, diagrammatic sketches, and drawings of the laryngoscopic appearance. The same arrangement is followed for malignant tumors of the larynx which are discussed in Part III.

This text is recommended to all radiologists not only for its excellent presentation of an important subject but as an example of an ideal method of teaching roentgen diagnosis as related to a special subject.

DIE HIRNKAMMERFORMEN BEI HIRNTUMOREN (Deformities of the Ventricles of the Brain Associated with Brain Tumor). By Dr. OTTO DYES, Dozent für Röntgenheilkunde, Würzburg. A volume of 78 pages, and 105 illustrations. Supplement 52, Fortschritte auf den Gebiete der Röntgenstrahlen. Published by Georg Thieme, Leipzig, Germany, 1937. Price: 16.20 R.M. bound.

This is an orderly and very practical consideration of the roentgenologic aspects of ventriculography. The first section concerns the methods of ventriculography and the technic of the x-ray examination. For the latter, the author uses two x-ray tubes, one mounted on the ceiling for exposures requiring a vertical x-ray beam, and the other mounted on a wall for exposures requiring a horizontal x-ray beam. The Potter-Bucky diaphragm is installed in an independent unit, the height of which is adjusted by means of an hydraulic plunger. This arrangement of x-ray devices would seem to be very practical and efficient. As a basis for the discussion of anatomical structures revealed by ventriculography the author has adopted the practical classification of Torkildson and Pirie. Pathologic conditions are considered according to the following classifications:

Symmetrical changes in the lateral ventricles:

1. Posterior horn deformities due to—
   - Occlusion of the foramen of Magendi;
   - Midline cerebellar tumors;
   - Pontine tumors;
   - Stenosis of the aqueduct;
   - Tumors in the posterior part of the third ventricle.
2. Anterior horn deformities—
   - Tumors in the anterior part of the third ventricle;
   - Tumors in the vicinity of the anterior horn.

Asymmetrical changes in the lateral ventricles:

1. Anterior horn defects associated with—
   - Frontal lobe tumors;
   - Tumors of the remaining portions of the cerebrum Zones I, II, III, and IV;
   - Tumors of several zones,
   - Tumors with obstruction of a lateral ventricle.
2. Posterior horn defects associated with—
   - Temporal lobe and thalamus tumors,
   - Other hemisphere tumors,
   - Tumors of the peduncles,
   - Lateral cerebellar tumors.
3. Intra-ventricular tumors.
4. Cystic tumors.
5. "Early diagnosis."

Dyes' consideration of the subject of ventriculography is not as comprehensive nor as informative as the contemporary monographs by Lysholm, but the illustrations in many respects are superior to those of the Swedish author. Both of these books emphasize the need for an English text concerning this subject.

THE ROENTGENOLOGIST IN COURT. By SAMUEL WRIGHT DONALDSON, A.B., M.D., F.A.C.R., St. Joseph's Mercy Hospital, Ann Arbor, Michigan. A volume of 230 pages. Published by Charles C. Thomas, Springfield, Illinois, 1937. Price: $4.00.

The use of roentgenograms and roentgenologic procedures has become such an intricate part of the everyday practice of medicine that this special text relating to the medicolegal aspects of the specialty is timely indeed. An endeavor has been made in the writing of this book to collect and comment upon a number of decisions dealing with medicine and the law. The selected cases and citations are those which in some manner or other involve or affect the use of x-ray and the roentgenologist. Decisions are cited covering the essential points and in instances in which differing decisions have been rendered in similar cases, both or all are quoted.

The text is arranged in fourteen chapters, as follows: Introduction, Relationship between Physician and Patient, Malpractice, The Physician and the Law of Agency, Malpractice Defense and Prophylaxis, Evidence and Testimony, Privileged Communications, Expert Testimony, Expert Witness Fees, X-ray Films as Evidence, Ownership of Films, Physicians and Contracts, "Doctor, Take the Stand," and Conclusion. In addition, there is a bibliography, key to citations, table of cases, and index. This book is highly recommended for all physicians and should be popular indeed with members of the legal profession. Many physicians will practise long without knowledge of its contents, others would have practised longer if they had read it.

ELEMENTARY SURVEY OF PHYSICS. By ARTHUR E. HAAS, Ph.D., Professor of Physics at the University of Notre Dame, with the collaboration of IRA M. FREEMAN, Ph.D., Associate Professor of Physics, Central College, Chicago. A volume of 203 pages. Published by E. P. Dutton & Company, Inc., New York City, 1938. Price: $1.90.

This book offers a concise and comprehensive survey of the whole field of physics. All of the fundamentals of the subject are reviewed, and a precise statement of the newer developments is added.

In discussing each branch of the subject, the author begins with fundamentals, presents and explains the basic generalizations essential to an understanding of modern concepts, touches briefly on all the principal subdivisions in the field, and concludes with a discussion of the recent trends.

A few important but simple mathematical deductions and formulæ are placed in a special Mathematical Appendix. Another appendix is on topics of special interest to premedical students, and a third brief appendix on "Physics and Civilization" is in the form of a concluding summary, and presents a brief account of the importance of physics and its applications in modern life.

This concise and excellent presentation of an important subject is recommended for all those who want to keep abreast of the developments in physics and for those who wish to know something about the fundamentals.

SURFACE AND RADIOLOGICAL ANATOMY. By ARTHUR B. APPLETON, M.A., M.D. (Cantab.), Professor of Anatomy in the University of London and Director of the Department of Anatomy in the Medical School of St. Thomas's Hospital, London; Late Fellow of Downing College, Cambridge; WILLIAM J. HAMILTON, M.D., B.Ch. (Belf.), D.Sc. (Glas.), F.R.S.E., Professor of Anatomy in the University of London at the Medical College of St. Bartholomew's Hospital, London; late Deputy Director of the Department of Anatomy in the Medical School of St. Thomas's Hospital, London, and IVAN C. C. TCHAPEROFF, M.A., M.D., B.Ch. (Cantab.), D.M.R.E., Assistant Radiologist at St. Thomas's Hospital, London. A volume of 311 pages, and 338 illustrations. Published by William Wood & Company, Baltimore, 1938. Price: $5.50.

The very fundamentals of efficient roentgenologic interpretation demand a thorough familiarity with anatomy and the orderly development of the specialty of roentgenology has resulted from such a correlation. On the other hand, because of the inherent advantages of roentgenologic procedures and the ease with which they can be applied to large groups for investigative purposes there has resulted a tremendous increase in our knowledge concerning the normal and normal variants of many anatomical structures. In many medical schools x-ray films have become an intricate part of the anatomy course. With the development of such a close relation of subjects it is not unexpected to find roentgenograms and roentgenologic data appearing with increasing frequency in anatomical texts. Except for specialized texts that have been prepared primarily for roentgenologists, this is one of the first books relating primarily to anatomy in which the radiological appearance of normal structures has been given a significant part in the text. It is difficult to understand just why a book concerned primarily with surface anatomy has been selected for this correlation, and surely our knowledge of roentgenology and that of anatomy have not been combined to the best advantage in this volume. As far as the skeletal system is concerned, much of the value of the roentgenograms is lost because the usual drawings and anatomical descriptions of the various bones are not available for comparison. This abbreviated presentation of an important subject may suffice for those for whom the text is primarily intended but certainly roentgenology has much more to offer to the subject of anatomy than is conveyed by this book.

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GYNECOLOGY AND OBSTETRICS

Radiotherapy in Non-malignant Uterine Hemorrhage. B. Windeyer. British Med. Jour., **2,** 1034–1037, Nov. 19, 1938.

The author discusses uterine hemorrhage, of non-malignant type, under the headings of (1) bleeding at or near the menopause; (2) bleeding associated with fibroids, and (3) bleeding in young subjects.

The effect of radiation is on the ovarian follicles. The more mature the latter, the more sensitive. Hence, the woman in the menopause with mature follicles is benefited by smaller doses than is the younger woman.

Radiation, either by radium or x-ray, is most desirable for the menopause case. The only exceptions are cases of extreme prolapse which would be better handled by surgery for the sake of the gross abnormality. The author discusses the relative merits of radium and x-ray and concludes that the latter is more favorable when available. Factors suggested are 200 kv. at 50 cm. distance with three fields, anteriorly, through a Thoraeus filter. Total dosage is 900 r to each area.

Bleeding with fibrosis is treated in like manner. Contra-indications are pressure symptoms, degenerative changes, and unusually large fibroids.

Indications for radiotherapy in young women are debatable. Statistics are cited which would favor moderate doses of radium or x-ray: the author prefers the latter. The possibility of abnormal children resulting from radiation is discussed and one is brought to the conclusion that previous fears regarding monstrosities were unwarranted.

Q. B. Coray, M.D.

HEART AND VASCULAR SYSTEM

The Concurrence of Radiologic Signs and Electrocardiographic Changes in Myocardial Damage. Friederike Barth. Schweiz. med. Wchnschr., **68,** 1376–1379, Dec. 17, 1938.

The author reports 500 cases of cardiac disease in which two-thirds showed a correspondence between fluoroscopic findings (pulsations of poor strength) and electrocardiographic changes, indicating myocardial injury. In one-third there was no agreement; that is, either the E.K.G. showed myocardial changes while pulsations were strong, or the E.K.G. was normal and the pulsations were weak. In cases showing weak pulsation, 96.2 per cent showed electrocardiographic changes, while in those showing poor strength pulsations, 89.3 per cent showed such changes. The author concludes that weak pulsation seen at fluoroscopy is very strong presumptive evidence of severe myocardial damage.

Lewis G. Jacobs, M.D.

Primary Sarcoma in the Peri-myocardium. P. Cossio and I. Berconsky. Rev. Argent. de Cardiol., **5,** 172–181, July and August, 1938.

Cossio and Berconsky report what they think is the twelfth case ever reported of primary sarcoma of the peri-myocardium, it being the first case reported in the Argentine.

The authors state that primary tumor of the heart is much rarer than secondary tumor and they quote Lymburner's 8,550 necropsies in which he found four primary and 52 secondary tumors. Benign tumors, they find, are four times as frequent as malignant. The authors quote Mendelstam, who, in 1923, made a rather complete search of the literature and found a total of 143 cases, 117 of which were benign.

The essayists state that the neoplasm at times takes origin in the sub-pericardial tissue and from there invades and extends along the myocardium, replacing it without forming tumor masses. When this happens, the real nature of the malady cannot be diagnosed, even if suspected, but if tumor masses are formed, the roentgenological diagnosis is feasible.

One point of special interest brought out in this report is that the clinician is often made aware of the condition and led to the correct diagnosis, during life, by different signs. Gottel, in 1919, diagnosed primary sarcoma of the left auricle on finding of mitral stenosis when the patient was in a standing position and insufficiency when he was in a prone position. Autopsy revealed the neoplasm to be in the right auricle.

In 1924, Bosco diagnosed metastatic sarcoma of the right auricle, in a patient who had a primary lung sarcoma, by finding auricular extrasystoles, a dense shadow of the heart silhouette, and neoplastic tumor cells in the pericardial fluid.

Rösler also, in 1924, diagnosed metastasis to the heart in a patient whose primary lesion was in the cheek when the patient developed auriculo-ventricular block.

Fishberg, in 1930, diagnosed metastasis of the heart when each of three of his cancer patients developed auricular fibrillation, auricular flutter, and angina pectoris, respectively. Williams and Amberg, in 1930, diagnosed metastasis in a patient who developed cardiac insufficiency shortly after a limb was amputated for sarcoma. Smith and Arbor, in 1937, diagnosed metastasis in a patient who developed dyspnea and a pericardial rub and who had been operated upon two years previously for melanoblastoma in the mastoid region, and in another, who developed dyspnea, edema, cardiac murmurs, and electrocardiographic changes, a primary tumor in the liver.

Antonio Mayoral, M.D.

INFLAMMATION

Radiation Therapy in Acute and Chronic Inflammatory Conditions. Henry Johnson Ullmann. Calif. and West. Med., **50,** 11–14, January, 1939.

This paper brings to the attention of the physician the various lesions in which irradiation has proven of value. It is well worth reading in order to remember that there are many simple lesions and diseases which respond satisfactorily to properly administered radiation.

The average physician is accustomed to consider radiation only in malignant disease, but he must realize that many times radiation will be great value to him in the treatment of inflammatory conditions.

JAMES J. CLARK, M.D.

The Roentgen Treatment of Inflammatory Diseases. Gage Clement. Minnesota Med., **21,** 847–849, December, 1938.

Clement reviews the factors which, in old equipment, were unstable and unpredictable, and points out that with present-day methods, dosage is so accurately measurable that equivalent energies are obtainable at will.

For many years the value of roentgen therapy in acne, furunculosis, and erysipelas has been well known. Other conditions are becoming recognized as amenable to therapy.

Recent work in Leningrad has shown the importance of the dose-time interval. Small doses given every other day had much better effect than larger doses given every fourth day, although the total amount of radiation was the same. This is readily understood when it is realized that only a short time is required to break down the phagocytic cells of the blood, liberating the antibodies or other substances contained therein. These antibodies act as antitoxins and have definite phagocytic properties after liberation. It must be remembered that the metabolism and function of parenchymal and connective tissues are increased by inflammation; therefore, physically equal doses have much greater effect on inflammatory tissue than on normal tissue.

Roentgen therapy should be started early to be effective. It should not be a last resort measure.

Gas bacillus infection has shown, when treated with x-ray, serum, local surgical procedures, and antiseptics, that in many cases the necessity of amputation has been removed. Kelly and Dowell, in a review of 56 cases, report a mortality of less than 10 per cent.

In the treatment of lobar pneumonia, Powell gives the results of the treatment of two groups of patients. One group received x-ray treatment and the other group was treated with serum. In the group which received serum, the mortality was 15 per cent, while in the group receiving x-ray treatment the mortality was only 5 per cent. These results are explained by the liberation of certain lysins from the infiltrating leukocytes by the action of the roentgen rays. This lysin causes the solution of the coagulum which is the principal component of the consolidation.

Other conditions amenable to roentgen therapy include arthritis, parotitis, bursitis, peritonsillar abscess, pyorrhea, endocarditis, bronchiectasis, puerperal mastitis, peritonitis, localized cellulitis, adenitis, endometritis, and many others.

The author quotes Desjardins, who seven years ago pointed out that the destruction of the leukocytes by x-ray exposure liberates the protective substances contained within them and makes them more effective for defensive purposes than they would be in their intact state.

PERCY J. DELANO, M.D.

THE LARYNX

Laryngocele. W. Likely Simpson. Ann. Otol., Rhinol., and Laryngol., **47,** 1054–1060, December, 1938.

A laryngocele is an air sac connected with the larynx. The sac may be either intra- or extra-laryngeal. It may develop in a normal larynx without any pre-existing pathologic condition or may follow such etiologic factors as singing, horn-blowing, glass-blowing, weight-lifting, vomiting, etc. Some cases develop due to a weakening of the wall by some disease such as syphilis, tuberculosis, or tumor.

The author's patient was a male, aged 32. There was a history of injury to the laryngeal region two years previously. A small mass had appeared at the midline of the larynx region and recently this had become larger and slightly reddened. Roentgenograms showed air in the sac and instillation of lipiodol into the larynx also revealed a connection between the sac and larynx. The lesion was removed surgically.

LESTER W. PAUL, M.D.

Radiography of the Larynx, Anterior View, and its Technic. R. Ledoux-Lebard, J. Garcia-Calderon, and Albert Djian. Bull. et mém. Soc. de Radiol. Méd. de France, **8,** 93–97, February, 1938.

By means of an especially shaped, semi-conical film, adapted to the form of the upper esophagus and pharynx, and inserted into the esophagus, the authors obtain excellent anterior and oblique views of the larynx, free of the vertebral shadows. The method is far superior to planigraphic methods and requires, in addition, only careful anesthesia of the pharynx.

S. R. BEATTY, M.D.

Tumors of the Larynx. Frederick A. Figi. Minnesota Med., **21,** 553–558, August, 1938.

The most common benign laryngeal growths, in order of frequency, are: Papilloma, myxoma, cysts, inflammatory masses, epithelial hyperplasia and leukoplakia, angioma, and amyloid tumor. Fibroma, chondroma, and xanthoma occur rarely.

Among the malignant neoplasms, carcinoma is the most common (epithelioma); sarcoma, hemangioendotheliomas, and adenocarcinoma form a smaller percentage.

Removal of papillomas and electrocoagulation of their attachment by means of direct, indirect, or suspension laryngoscopy offers the best chance of cure. Roentgen therapy and radium are inferior to coagulation. Treatment is similar for myxoma.

Cysts may sometimes be left alone, unless too large. They are usually situated in the vallecula. When removal is necessary, this is done, followed by electrocoagulation.

Singers' nodes are a form of chronic laryngitis. They are usually situated at the junction of the anterior and middle thirds of the vocal cords and are caused by faulty voice production. They may disappear or may have to be removed.

Angiomas may be treated by radiation therapy unless they are causing severe symptoms.

Carcinoma of the larynx is usually classified as extrinsic and intrinsic. The intrinsic tumors are those which spring from the vocal cords, ventricular bands, ventricles, interarytenoid region, and subglottic region. The extrinsic growths are those which spring from the epiglottis, aryepiglottic folds, arytenoid cartilages, pyriform sinuses, and post-cricoid region. The earliest symptom of carcinoma of the larynx is usually hoarseness.

Biopsy is a routine procedure. For lack of it, laryngectomy has been done needlessly.

Without treatment, death occurs in from one to three years. Radical surgery is preferred by the author to radiation therapy, which is reserved as adjuvant treatment. Despite the enthusiastic reports of those who have been employing the Coutard method of protracted fractional radiation therapy, the writer feels that the time is not yet here when surgery can be foregone in the majority of cases.

PERCY J. DELANO, M.D.

THE LUNGS

Non-putrid Pulmonary Suppuration. Marcy L. Sussman. Am. Jour. Roentgenol. and Rad. Ther., **40,** 22–37, July, 1938.

Suppurative bronchopneumonia is a pneumonitis due to non-putrefactive pyogenic bacteria with the formation of pus in, and sometimes necrosis of, the bronchial walls and pulmonary parenchyma. Commonly, this condition complicates purulent sinusitis, whooping cough, measles, influenza, grippe, and aspiration of a foreign body or secretions, as in postoperative pneumonia.

The clinical course is mild and spontaneous resolution is the usual outcome even when abscesses are present. In the severer cases, single or multiple abscesses, as well as free or encapsulated fluid pockets, may form. Atelectasis and bronchial dilatation may occur, with only the latter as a possible permanent result. The roentgen findings will naturally vary with the type present.

S. M. ATKINS, M.D.

Pathological Physiology of Pulmonary Cysts and Emphysematous Bullæ. Nolan L. Kaltreider and Walter W. Fray. Am. Jour. Med. Sci., **197,** 62–77, January, 1939.

The functional studies on six cases of pulmonary cysts and emphysematous bullæ are presented. The majority of the cases had pulmonary fibrosis and obstructive emphysema.

In half the cases, the total and vital capacities are reduced and the residual air only slightly increased. The evidence suggests that in most of the cases, the cyst volume is not included in the residual air. In the remaining cases, the changes are typical of obstructive emphysema, *i.e.*, a marked decrease in the vital capacity and an increase in the residual air, resulting in a normal value for the total capacity.

The volume of the chest is larger than normal and assumes the barrel-shape characteristic of obstructive emphysema. In about half the cases, there is a slight retention of carbon dioxide and a certain degree of anoxemia. The pulmonary reserve is reduced in cases of emphysematous bullæ and congenital cystic diseases. Dyspnea, the degree of which is closely related to the decrease in vital capacity and the expansion of the chest, may be explained by the mechanical impairment of the respiratory bellows.

Cystic disease of the lung is usually classified as acquired and congenital. The cysts may be unilateral or bilateral, solitary or multiple, and contain fluid or air. The patients in this series had certain things in common; a history of respiratory infection; five had respiratory insufficiency; all had emphysema, fibrosis, or both, and three had paroxysms of bronchial asthma.

Bullæ, the result of emphysema, may produce round shadows in the lungs, and, on the other hand, congenital changes may not appear until later life, if at all. It is often clinically impossible to distinguish between congenital cystic disease of the lung and emphysematous bullæ. In the two roentgenographically similar cases, one patient had marked respiratory embarrassment, while the other had only slight breathlessness after exercise.

BENJAMIN COPLEMAN, M.D

The Diagnosis of Extrapleural Abscesses. Hans, Gösta Skarby. Acta Radiol., **19,** 259–272, September, 1938.

Skarby describes the roentgenological and clinical appearances of five extrapleural abscesses (abscesses between the parietal pleura and the thoracic wall). Four of these abscesses were of tuberculous origin; one was due to staphylococcus infection. Tuberculous osteitis of a rib was present in several cases. The author discusses the differential diagnosis of the disease by which empyemas, endotheliomas, and other tumors of the pleura, pulmonary actinomycosis, etc., must be excluded.

ERNST A. SCHMIDT, M.D.

The Diagnostic Value of Pulmonary Radiography in Primary Tuberculous Angina: Insufficiency of Radioscopy. Louis Weigel. Bull. et mém. Soc. de radiol. méd. de France, **26,** 533, 534, July, 1938.

In the diagnosis of acute angina, it must be remembered that tuberculosis often manifests itself as a painful infiltration of the palate with dysphagia and later ulceration and membrane formation. The diagnosis is usually made by a process of elimination, *i.e.*, from diphtheria, Vincent's angina, syphilis, etc.

Too often a fluoroscopic examination is made and a report of no pulmonary disease is accepted, when, as a matter of fact, many lesions including miliary tuber-

culosis, commonly associated with tuberculous angina, cannot be visualized on the fluoroscopic screen. The only safe radiologic procedure is radiography with proper technic.

S. R. BEATTY, M.D.

Roentgen Diagnosis of Lung Embolism. Nils Westermark. Acta Radiol., **19,** 357–372, October, 1938.

X-ray examination allows a differentiation between pulmonary embolism with infarctation and embolism without infarctation.

In embolism without infarctation, we observe ischemia of the branches of the pulmonary artery distal to the embolus. In the roentgenogram, this ischemia appears as a clarified area with a diminution of the vascular pattern in the region supplied by the occluded artery. In the central portions of the lung, however, the vascularization is maintained. The border between vascularized and non-vascularized areas is sharp, but the phenomenon is of transient nature and may change within a relatively short time.

In embolism with infarctation, the typical wedge-shaped area of radiopacity is pathognomonic, but even in cases in which infarctation is present, other parts of the lung may show larger or smaller wedge-shaped clarifications pointing to simultaneous embolisms without infarctation.

ERNST A. SCHMIDT, M.D.

Lung Abscess Due to Esophageal Overflow. D. Alan Sampson. New England Jour. Med., **219,** 982–985, Dec. 22, 1938.

Sampson reports a case of chronic lung abscess with the classical findings but, in addition, there were gastric complaints, which, upon investigation by means of a barium meal, revealed a greatly dilated esophagus due to cardiospasm. It is believed that overflow of the esophageal contents resulted in the pulmonary infection.

Review of the pertinent literature reveals that a pulmonary abscess may, in addition, result from a foreign body in the esophagus, pulsion diverticulum, carcinoma of the esophagus, or a benign structure. These are conditions to be investigated when a cause is sought for lung abscess.

JOHN MCANENY, M.D.

The Association of Silicosis and Carcinoma of the Lung. Max O. Klotz. Am. Jour. Cancer, **35,** 38–49, January, 1939.

An extensive review of the literature on this subject is presented, together with four additional case reports of patients dying with both carcinoma of the lung and pneumoconiosis. The literature is divided as to the possible carcinogenic influence of silicosis, but the tendency is to support the contention that silicosis or other forms of pneumoconiosis may play a part in the production of primary carcinoma of the lung.

The author's four cases were found among a group of 50 autopsies on patients with pneumoconiosis, an incidence of 8 per cent. This was compared to an incidence of 53 cases of carcinoma of the lung in 4,500 routine autopsies, or 1.17 per cent. This suggests some factor in silicosis which predisposes to the development of carcinoma of the lung.

Although the tumors were large, in three of the four cases, none could be diagnosed by roentgen examination even in retrospect.

H. O. PETERSON, M.D.

Tuberculous Ulcerations of the Lung and Pulmonary Cavities. Bruno Faccini. Arch. di Radiol., **14,** 279–303, 1938.

This is a discussion of the differential diagnostic roentgenologic features of these lesions, with characteristic roentgenograms.

E. T. LEDDY, M.D.

The "Azotemic Lung": Radiographic Study. C. Roubier. Jour. de méd. de Lyon, **19,** 467–473, Aug. 5, 1938.

The author calls attention to certain radiographic findings in the lungs of those individuals suffering from nitrogen retention. This consists of the appearance of spots, more or less confluent, giving a dappled or flocculent effect, which predominate in the mid-lung or parahilar regions and are, in certain cases, localized to the right lung. Such a picture naturally makes one think of tuberculosis, especially as certain spots with relatively clear centers simulate cavities.

These lesions are essentially regressive, disappearing progressively as the blood urea returns to normal.

The anatomico-pathologic substrate is a pronounced pulmonary edema without other macroscopic lesion. Histologically, there is found an intra-alveolar serous exudate, with, at times, some inflammatory cells.

S. R. BEATTY, M.D.

Congenital Lung Cysts: Air Expansile Types. William Willis Anderson. South. Med. Jour., **31,** 628–632, June, 1938.

Two cases of lung cysts are reported. This type is assumed to be congenital in origin. It starts as an intrapulmonary fluid sac, lined with secreting epithelium, increases in size, particularly during pulmonary infections, and ruptures into a bronchus, forming an air trap into which air can enter but not escape.

Roentgenographically, it may be confused with emphysematous blebs, or, when extremely large, with a pneumothorax. Fluid cysts before rupture should be suspected in atypical pneumonic processes and such cases should have chest roentgenograms made at the end of their acute stages.

The prognosis of air-expanding cysts is grave. A high percentage occur in infancy. The use of the thoracoscope and cauterization of the aperture with sclerosing solutions is a logical form of treatment and surgery will probably reduce the high mortality rate in the future.

JOHN M. MILES, M.D.

The Division of the Lung Segments in the Right Upper Lobe. E. Behr and Eelco Huizinga. Acta Radiol., **19**, 399–407, October, 1938.

The investigation of the right upper lobe in 108 lungs showed that no fixed scheme for the ramification of the bronchial tree and the division into lung segments exists. However, a particular type of ramification, a trifurcation, occurs most frequently, although the anatomical variations are numerous. In about 40 per cent of the examined lungs, a bifurcation was found in the right upper lobe.

The author concludes that if in any clinical case a definite knowledge of the anatomical conditions and relations is required, it is impossible to rely on any theoretical considerations but bronchography must be resorted to.

ERNST A. SCHMIDT, M.D.

Radiographic Studies of the Excretion of Dusts from the Lungs. A. E. Barclay, K. J. Franklin, and R. G. Macbeth. British Jour. Radiol., **11**, 405–413, June, 1938.

The authors' first study was undertaken to extend their knowledge of the efficiency of the ciliary action in the bronchial tree in removing small particles of inhaled dust. The normal mechanism for removing inhaled dust consists of the ebb and flow of air in the bronchi, the action of the cilia, and coughing. Coughing cannot be regarded as a normal mechanism of removing dust from the finer bronchi as it is the result of irritation in the upper respiratory passages and removes mucus which contains suspended particles; it is primarily a reserve mechanism. The ciliary action is by far the most important normal mechanism. The normal defensive mechanism of the lungs is exceedingly effective in preventing dust from reaching the alveoli.

India ink, placed in the main bronchus of a sheep's lung not far from the tracheal bifurcation, very quickly crosses the bifurcation. It apparently divides at the bifurcation, one stream going up the right, and the other to the left into the trachea. In the trachea the particles move in a spiral manner, clockwise. A similar drift was noticed in a cat's trachea. India ink injected sub-pleurally into a cat appeared in the upper trachea in 14 minutes, during which time it had travelled 12 cm.

Ciliary action is impeded if there is too little or too much mucus. Furthermore, if the mucus is too thick, the cilia cannot move it freely. The cilia may be destroyed by inflammatory conditions which will seriously interfere with removing dust from the lungs. The ciliated epithelium disappeared near the border of the bronchioles of 0.2 mm. in diameter.

Experiments were performed on cats. Two types of opaque dust were used, bismuth carbonate and powdered lead glass. With the assistance of a laryngoscope, a small tube was passed into the trachea to the bifurcation and the dust blown in with an insufflator under fluoroscopic control. In each instance, the dust was seen to go only to the smaller bronchioles; it did not penetrate the alveoli. The radiographic examinations were made, subsequently, to see how rapidly the dust was excreted. Two observations were made; the time in which most of the dust was removed, and the time when the last trace disappeared. The figure for the disappearance of dust was quite reliable, and was checked with postmortem examinations.

In 14 instances using bismuth subcarbonate, the mass of dust had disappeared in 40 minutes and the lungs were clear in 20 hours. Fifteen cats were insufflated with powdered lead glass. This dust was eliminated considerably faster than bismuth carbonate, complete clearing occurring in some cases in about half the time. Repeated insufflations of dust did not affect the speed of excretion.

The addition of 2 c.c. of 1:20,000 acetic acid into the lungs *before* the dust was insufflated did not slow up excretion; however, when 2 c.c. of 1:20,000 acetic acid or normal saline was insufflated *after* the dust, or the dust suspended in saline, spreading of the dust particles into the alveoli was caused, and the excretion was much prolonged.

After the animal was killed, this lung was found to be nothing but a fibrous mass, due, the authors believe, to shrinkage and collapse of the lung caused by disuse.

SYDNEY J. HAWLEY, M.D.

THE MASTOID

Acute Mastoiditis. J. G. Parsons. Minnesota Med., **22**, 12–14, January, 1939.

The most commonly met picture in acute mastoiditis is post-aural pain, tenderness, and discharge which has been present for some time before the onset of the other symptoms and which has lessened just prior to their onset.

The most common avenue of infection of the middle ear is through the eustachian tubes, by continuity of tissue from an infected naso-pharynx, the infection being forced through a patent tube by blowing the nose, coughing, sneezing, or vomiting. The infection may also be carried by blood and lymphatics.

Infection of the middle ear practically always means infection of the mastoid antrum, where germs of a more virulent type find their way to the mastoid air cells.

Adequate drainage of the middle ear is an important step in heading off mastoiditis. One of the fallacies commonly met with is that there is no great danger of mastoiditis if an ear is draining freely; it is essential to see the drum head and note the size of the opening.

Post-auricular edema is an important sign. The most important condition to be differentiated is furuncle of the external canal.

An ear which has been discharging for more than a week, without diminution, should be held under suspicion.

In the discussion it was pointed out by Dr. Walter E. Camp that one type of acute mastoiditis was especially treacherous—that in which there was a minimum of clinical symptoms, *i.e.*, slight pain and discharge;

and that this type, which might go on to meningitis, showed only slight cell destruction on x-ray examination.

For correct diagnosis repeated x-ray examinations are often necessary.

PERCY JOSEPH DELANO, M.D.

PEPTIC ULCER

The Radiologic Characteristics of the So-called "Large Duodenal Ulcer." D. S. Bartstra. Acta Radiol., **19,** 352–356, October, 1938.

While, in general, the size of a duodenal ulcer varies between a barley grain and a bean, the so-called "large duodenal ulcer" may assume the size of a walnut. In spite of this large size, the niche often escapes radiological detection. This may be explained in some cases by the marked duodenal deformity; in other cases the large ulcer niche is misinterpreted as a duodenal bulb.

A case is described which illustrates the essential diagnostic features, especially with regard to differentiation from a duodenal bulb.

ERNST A. SCHMIDT, M.D.

Double Ulcer of the Stomach: Radiographs and Specimen. Vincent Paschetta. Bull. et mém. Soc. de radiol. méd. de France, **26,** 343, 344, May, 1938.

Radiographs of a case demonstrated an atypical niche of the lesser curvature and a deformed bulb, which, to the examiner, indicated a duodenal ulcer. Operation showed a perforating ulcer of the lesser curvature, a smaller ulcer of the lesser curvature, not seen on the radiographs, and peri-duodenal adhesions caused by the larger ulcer of the lesser curvature.

S. R. BEATTY, M.D.

Peptic Ulcer of the Esophagus. Flemming Norgaard. Acta Radiol., **19,** 458–464, November, 1938.

As the author points out, peptic ulcer of the esophagus is a rather uncommon disease and the cases in which it has been diagnosed primarily by roentgen examination are not frequent. However, the roentgenogram reveals characteristic changes which should not be overlooked in routine examination of the esophagus. The most common observation is spasm; occasionally broad folds of mucosa are seen, indicative of esophagitis. Contrast-filled ulcer niches can be demonstrated only rarely but the combination of spasm and niche must be considered pathognomonic. It is extremely important that in doubtful cases the examination be repeated several times, especially during periods of exacerbation of the symptoms. Such exacerbations may be provoked artificially for the purpose of x-ray study.

Norgaard reports the case of a seven-year-old girl whose first symptoms (vomiting) dated back four years. The radiologic examination showed esophageal spasm and dilatation without evidence of cicatrization. A later examination revealed a contrast shadow of small pea size, projecting slightly to the side of the lumen at the level of the tenth thoracic vertebra. Surrounded by a rarefied annular zone, it gave the appearance of an ulcer niche. Esophagoscopy failed to furnish further details due to bleeding. Under sodium bicarbonate treatment, and after introduction of duodenal sounds, the patient's condition improved remarkably, though milder recurrences continued to appear.

ERNST A. SCHMIDT, M.D.

The Problem of Gastroduodenal Hemorrhage. Albert M. Snell. Minnesota Med., **22,** 15–24, January, 1939.

The commonest cause of gastro-intestinal bleeding is duodenal ulcer. Less common is secondary anastomotic or recurrent ulcer. Gastric carcinoma is third in order of frequency.

Gastroduodenal hemorrhages seem, in some cases, to follow sudden physical exertion; in others, abuse of alcohol; acute infections may be a cause, and a fourth reason is possibly vitamin deficiency. The antihemorrhagic vitamin K must be given consideration under this heading.

Many of the bleeding ulcers are of the so-called silent type in that they produce few symptoms at the time. Other patients do have prodromal symptoms of a dyspeptic nature.

Regeneration of blood, after the hemorrhage has ceased, requires about 33 days.

At Guy's Hospital, in London, only 25 deaths from bleeding peptic ulcer occurred in 20 years, whereas the mortality rate in Scandinavian countries seems to range between 10 and 15 per cent. At King's County Hospital, in Seattle, the mortality rate is about 20 per cent. At the Cincinnati General Hospital the rate is 14 per cent. Goldman's mortality figures (San Francisco) show 11 per cent. The mortality rate in the Mayo Clinic is now about 5 per cent.

There is some evidence that hemorrhage from a gastric ulcer is more likely to result fatally than one from the duodenum.

The more serious types of bleeding occur in older individuals; the average age at which fatal hemorrhage occurs in 56 years. In patients past 50 years of age the mortality rate in the Massachusetts General Hospital is approximately 33 per cent. In older patients the eroded artery is often sclerotic.

Individualization of treatment is important; slight degrees of bleeding are usually controlled by conservative measures but more extensive bleeding requires maintenance of blood volume and renal function. Massive or arterial hemorrhage can rarely be controlled except by surgical attack.

The early administration of food after a hemorrhage is receiving more and more favorable consideration; the filled stomach probably has less peristaltic activity than the empty one. It is the practice at the Mayo Clinic to withhold food for from 24 to 48 hours, or until such time as evidence of rapid loss of blood is no longer apparent. After this period, small hourly

feedings of ice water, gruel, milk, and sweetened fruit juices are allowed, and, if no further bleeding occurs, the patient is allowed to take a generous soft diet in the form of five or six feedings at appropriate intervals on the following day. Alkalies may or may not be administered, depending on whether or not ulcer pain is present.

Arguments are presented for and against the surgical attack on bleeding ulcers. At the Mayo Clinic recent experiences with direct attack on the ulcer have been encouraging.

The duration of the individual hemorrhage, the age factor, the previous history, and the availability of proper facilities for maintaining the blood at a point above the level of exsanguination, often influence the decision as to the desirability of a direct surgical attack.

PERCY JOSEPH DELANO, M.D.

Insufflation of the Colon as a Method of Diagnosis in Gastrocolic Fistula Following Post-operative Jejunal Peptic Ulcer. Louis Weigel. Bull. et mém. Soc. de radiol. méd. de France, **26,** 532, 533, July, 1938.

The author reports a case of gastrocolic fistula resulting from perforation of a jejunal ulcer (post-gastro-enterostomy). He found that insufflation of the colon with air was useful in demonstrating the lesion and he recommends this procedure.

S. R. BEATTY, M.D.

PHYSICS OF RADIATION

The Scattering and Photo-electric Absorption of High Voltage X-rays in Nitrogen. Harold C. Trueblood and Donald H. Loughridge. Phys. Rev., **54,** 545–554, Oct. 15, 1938.

This article presents a detailed study of an automatic cloud chamber under the 800 kv. General Electric installation, in Seattle, and concerns the analysis of the complicated mechanism of absorption of extremely high voltage x-rays.

The author found 100 recoil electrons to one photo-electron, in contrast to the theoretical value of about five thousand. A careful study of the angular distribution of the recoil electrons was made, and also of the photo-electrons, which are scattered not quite so much in a forward direction, predominately, as the recoil electrons.

R. R. NEWELL, M.D.

Cerenkov Radiation. George B. Collins and Victor G. Reiling. Phys. Rev., **54,** 499–503, Oct. 1, 1938.

This is an investigation of the radiation in the visible region produced when electrons pass through matter at a higher velocity than the velocity of light in that matter. The radiation is asymmetric, and is distributed through the whole visible spectrum, being on the whole of rather a blue color. Electrons accelerated at 1.9 million volts in an electrostatic generator and tube were found, each one, to produce 40 quanta in the wave length range between 4,000 Å. to 6,700 Å. It is interesting to a radiologist to discover that high speed cathode rays can produce visible light under some circumstances, as well as x-rays, on bombarding matter.

R. R. NEWELL, M.D.

PLANIGRAPHY

A Fundamental Property of Planigraphic Image Formation. R. H. De Waard. Acta Radiol., **19,** 465–479, November, 1938.

In this paper De Waard reports his experiments aiming to test the supposition that a roentgenogram obtained by planigraphy corresponds to a definite cross-section of the examined object and forms an adequate representation of this cross-section. A special apparatus was employed for this purpose, modified after Grossmann's tomograph. Sets of planigraphs were obtained of both spherical and cylindrical objects. The images of most of these so-called planigraphs differed considerably from the corresponding cross-sections. It is, therefore, obvious that planigraphs can in no way be considered adequate images of the corresponding cross-sections.

The cause of these differences is discussed and explained in detail.

ERNST A. SCHMIDT, M.D.

New Applications of Planigraphy to the Physiology and Pathology of the Larynx. Canuyt, Gunsett, and Greiner. Bull. et mém. Soc. de radiol. med. de France, **26,** 507–520, July, 1938.

Planigraphy, by eliminating the detail of the cervical column, permits *en face* views of the larynx, allowing the study of details impossible to obtain by profile radiography. The authors present, in this article, reproductions of planigraphs showing the larynx in different phases of phonation, the anatomical variations dependent on mutism and eunuchoidism, the changes accompanying acute laryngitis, and the extent of involvement in a case of papillomatosis.

Two cases of cancer of the larynx, demonstrated by planigraphy following failure of discovery by laryngoscopy, are presented in detail. Planigraphs were useful in following the response of these lesions to treatment.

Laryngeal planigraphy is a valuable adjunct to other methods of examination. It is much more convenient and inclusive than the method of Rethi (intralaryngeal film) and permits study of physiologic processes in this region.

A bibliography of papers on planigraphy of the lung and larynx by members of this group is appended.

S. R. BEATTY, M.D.

PNEUMONIA

The Chronic Pneumonias. J. G. Scadding. Proc. Royal Soc. Med., **31,** 1259–1271, September, 1938.

The author considers the subject in the light of eight personally observed cases, and of the literature.

He believes that chronic pneumonia is characterized primarily by alveolar exudate, and, secondarily, by the possible development of fibrosis and suppuration. The involvement may be chronic from the beginning. Resolution may occur at any stage, with more or less fibrosis. Fatal cases have simulated tuberculosis both clinically and roentgenographically. Autopsies revealed widespread foci, having an unusual variety of modes of progress and spread, early and resolving consolidations, organization, and suppuration, in different lesions and in different parts of the same focus. These cases seem to establish chronic pneumonia as a clinically recognizable cause of protracted, progressive, or recrudescent disease. Scattered foci are rare, but a large number of more circumscribed pulmonary inflammations may have the above pathologic basis. A rarer giant-cell type of organizing pneumonia and the chronic phase of Friedländer pneumonia are cited.

Chronic Circumscribed Non-suppurative Pneumonia.—This group includes the usual delayed resolution of acute pneumonia. Resolution may require as long as 85 days. The eventual clearing may be complete, with little or no fibrosis. Therefore, consolidation may have prolonged suspended activity. It may arise insidiously or mildly and yet finally completely resolve, which may be most confusing clinically.

Chronic Suppurative Pneumonia.—Fibrosis or suppuration may occur instead of complete resolution. Suppurative symptoms are prominent, but gross abscess, if present, is incidental to the course of the disease. The pathologic features are irregular consolidation, incidental small abscesses, and fresh spreading consolidations, which may or may not excavate. The spread may wander spectacularly.

Pulmonary Abscesses of Obscure Origin.—Such abscesses constitute from 14 to 35 per cent of the total. Symptoms of abscess are dominant. At autopsy, the chronic pneumonic changes are apt to be considered secondary, but recognition of this underlying pathology helps explain the puzzling behavior of these cases.

Etiology.—Chronic suppurative pneumonia seldom follows acute pneumococcal pneumonia, though rarely a benign aputrid necrosis may occur. The author has found *Staphylococcus viridans*, gram-negative diplococci, non-hemolitic streptococci, *S. aureus*, pneumococci, *H. influenza*, Vincent's spirochetes and fusiform bacilli in his cases. The clinical courses and bacteriology did not correlate; even Vincent's organisms appeared to be secondary invaders.

Treatment.—The treatment of non-suppurative cases is general and symptomatic. Suppuration without gross abscess may benefit by continuous postural drainage. Localized abscess, without bronchial evacuation, requires surgical drainage, but the results are less satisfactory than with abscess of known etiology.

Arsenicals have shown the author only temporary improvement, even in cases in which Vincent's organisms were numerous. Sulphanilamide was ineffective in two cases. Blood transfusion is important when a falling hemoglobin cannot otherwise be restored.

RAY A. CARTER, M.D.

PNEUMOTHORAX

The Regression of Contralateral Tuberculous Lesions after Monolateral Therapeutic Pneumothorax. V. de Luca. Minerva Med., **1**, 321–329, March 28, 1938.

From a study of 99 cases the author feels that monolateral pneumothorax in the majority of instances has a favorable effect on contralateral lesions, but exudative forms may show only a transitory benefit.

E. T. LEDDY, M.D.

Bronchographic Observation of Re-expanded Lungs Following Artificial Pneumothorax. Giuseppe Zorzoli. Radiol. Med., **25**, 881–897, October, 1938.

The author believes that in collapse therapy the time of re-expansion is most delicate, and he has made a lengthy bronchographic study of re-expanded lungs which were subjected to the treatment for cure of tuberculosis.

He quotes extensively from different workers who have done experimental pneumothorax in healthy animals, and notes what is generally believed, *i.e.*, that in healthy lungs pneumothorax causes no appreciable permanent damage even if long-sustained; while in re-expanded tuberculous lungs, bronchial dilatations are frequent. The author cites words of Montanini, who, in 16 cases, found 10 with marked bronchiectasis, and in 62 per cent of these it was located in the lower lobe.

In the pleura the changes were layers of fibrous deposits over the membrane, which, when it became organized, interfered with the expansion of the lung.

This writer, going into the subject of his paper, presents bronchographic findings of the changes brought about in the parenchyma, bronchi, and pleura by the collapse in tuberculous and non-tuberculous patients.

In 25 patients, 27 lungs were collapsed. Of these, 16, or 58 per cent, showed bronchiectasis and in 67 per cent of those showing bronchiectasis, the lesions were limited to the upper lobe. In all but two cases the ectasia was cylindrical in type, the two exceptions being saccular. In these two, however, there was suspicion that the dilatation antedated the collapse.

The fact that most of the dilatations were found in the upper lobe was of special interest, because the lower lobe is generally believed to be the site of predilection for this lesion. The reason for the discrepancy appears to be due to the difficulty of diagnosing the condition in these lobes, clinically, as well as in plain roentgenograms, because there is no retention of the secretion due to good drainage, and because bronchography of this region presents technical difficulties.

From these data, it is evident that there is much discrepancy between the author's findings and those of Montanini. The latter, however, was based on pathological specimens, and he found only one case of bronchiectasis of the upper lobe in 16 cases reported.

The author does not believe that this discrepancy is due to dilatations produced by the oil injected, nor to

errors in technic, but believes the difference to be in the material used in the studies.

In seven of the eight cases of basal bronchiectasis, the collapse was done because of lesions at the apex. In the eighth case the lesion for which it was instituted was a progressive capillary advancing tuberculous bronchopneumonia. It is evident, therefore, that there is no definite relation between the site of the old tuberculous lesions and bronchiectasis. Hence it becomes necessary to invoke collapse and consequent re-expansion as the etiologic factor of producing bronchiectasis in healthy lungs.

While studying pathological specimens of collapsed lungs, we have seen how the compression can cause atelectasia of the alveoli, especially of those in the peribronchial region where they are compressed against the rigid bronchial tubes. In these atelectatic zones, the alveoli become so matted together that they always initiate carnification of the lungs. This, at the period of re-expansion, presses on the bronchial walls thereby narrowing the lumen. When to this extrinsic force is added the intrinsic trauma of deep inspiration and cough, the necessary requisites to cause bronchiectasis are found, as the defensive action of the normal alveoli is lacking. These mechanical factors are aggravated by retained sputum which causes inflammation of the bronchial mucosa.

CONCLUSIONS

Bronchial dilatations, more or less marked, with dislocation of the bronchus showing alterations in its branches, occur frequently in the re-expanded lung (58 per cent).

The bronchiectasis could be due to the lesion, for the cure of which it was instituted, or by the pneumothorax itself.

In the re-expanded lung, bronchiectasis is more common in the upper lobe (68 per cent).

Bronchiectasis at the apex is irregular and tortuous, showing alternating narrowings and dilatations resembling a multiple hour glass, while at the bases the bronchi nearly retain their primitive position and the dilatations are cylindrical.

The duration of the collapse appears to have no bearing on the production of bronchiectasis. It does appear, however, that the time the lung has been re-expanded is very important, in the sense that the dilatations are more apt to appear as a late complication. Special care should be exercised during the period of re-expansion, because if a rapid expansion is allowed bronchiectasis is more likely to develop than when the re-expansion is done gradually and slowly.

ANTONIO MAYORAL, M.D.

RADIATION

Superficial Radiotherapy: Contact Radiotherapy (Chaoul). W. Gassmann. Bull. et mém. Soc. de radiol. méd. de France, **26,** 534–540, July, 1938.

The general trend in radiotherapy has been toward a decrease in wave length and an increase in depth dose obtained by the use of higher voltages, increased filtration, increased tube distance, and cross-firing. Even with voltages sufficient to give wave lengths in the neighborhood of those of radium, the results to date have not demonstrated that ultra short roentgen rays produce clinical results equivalent to those of radium. Moreover, there is ample evidence that there is no selective action of short wave lengths *per se*.

The chief differences between roentgen therapy and radium therapy, aside from the difference in wave length, are in (1) geometric distribution of the energy, (2) the time factor, and (3) the total dose.

With these points in mind, Chaoul has devised a method of applying roentgen rays at very short focal-skin distances employing relatively large doses. Fractionation of the dosage is retained, but the time of the individual exposure is less, as protraction of the dose is regarded as of less importance than fractionation and the short time is not only economical but convenient, in that it facilitates treatment in the buccal cavity, vagina, rectum, etc.

A special tube is employed, completely shock-proofed, with the anode at extremity of the tube and at ground potential. A focal-skin distance of 5 cm. can be obtained with a consequent rapid decrease in the depth dose which, combined with a small field (20 $cm.^2$ maximum) allows a very high total dose with a minimum of injury to normal tissue.

The voltage employed is 60 kv., the filtration 0.2 mm. Cu, and the rate from 100 r to 150 r per minute. Daily doses of 500 r are given. With small fields, total doses of from 8,000 to 10,000 r may be given; with larger fields the doses should not exceed from 6,000 to 7,000 r.

Chaoul has used this method for six years and the author has had the opportunity to observe his cases. In cases of carcinoma of the lip and skin there has been 95.4 per cent cure of the primary lesion. The results in melanosarcoma surpass those of any other form of radiation therapy. The results in other lesions have been so good as to lead Chaoul to attempt the treatment of deeper tumors by surgical exteriorization. In 14 cases of inoperable rectal carcinoma, the coccyx and sacrum have been excised and the rectum split, to allow direct irradiation. Later the colostomy is closed and the rectum resected, the bowel then being sutured to the anus. Twelve of these cases have, to date, no evidence of recurrence or metastasis. One case died of a concomitant disease. A similar procedure has been tried in cancer of the bladder.

The method of Chaoul is superior to other methods of roentgen therapy and a more universal trial of this method is urged.

S. R. BEATTY, M.D.

RADIOLOGY, PRACTICE OF

Discussion on the Planning and Organization of a Radiological Department in a General Hospital. Proc. Royal Soc. Med., **31,** 1081–1096, July, 1938.

Dr. R. S. Paterson: The x-ray department should

be located as centrally as possible, on a ground floor, to serve equally well the wards, the orthopedic department, and the out-patient department. The author says: "I would be much more ready to consider some forms of decentralization than I would have been ten years ago." Subdivision in the department, with rooms and, sometimes, special assistants for special types of work, is better than allocating x-ray equipment among special services outside the department. The latter is uneconomical; service and quality of work would suffer. Yet specialty needs cannot be served in a department already loaded with routine, since considerable time per patient is often required. A small operating amphitheatre with sterilizing and anesthetic rooms in the x-ray department would best care for bronchoscopic and urologic examinations, insertion of pins, injection of arteries, etc.

Regarding dissociation of radiodiagnosis and radiotherapy the author recognizes three schools of thought: (1) Those who would completely separate radiotherapy and radiodiagnosis as having nothing in common; (2) those interested only in cancer, who would treat all cases independently of the x-ray department or the hospital, and (3) those who think radiotherapy and radiodiagnosis should be combined in general hospitals.

The author believes considerable separation must come but that there is sufficient in common to justify location in the same building with much of the staff in common, especially lay and technical.

Physical equipment should include a central waiting hall, accommodating about fifty patients with proper lavatory facilities, and at least twelve small dressing cubicles, six for male and six for female patients. Instead of several large machines (four and six valves) the author prefers a number of one- and two-valve sets in small rooms with a radiographer each. Most of the work can be handled by small sets, only one large one being required. The keyrooms are the darkroom and the office through which all work must go. The author prefers several small intercommunicating darkrooms, centering about a wet viewing room and drying room, rather than one large one. The washing tanks should be designed to push through the wall into the wet viewing room. He would prohibit entrance to the darkrooms during working hours. Films are to be seen in the wet viewing room and dried in the drying room, which the author thinks less expensive to build than to buy commercial drying cabinets.

Dr. Paterson finds a demand for clinical photography in his department but believes it better to handle this in an especially equipped studio and darkroom.

In general hospitals, the x-ray department becomes more and more costly. The author would have a full-time almoner to interview all patients in order to exclude those who are above scale and to collect a partial payment from those who can afford something toward the cost. The unnecessary examination also increases cost and finds its source in the increasing tendency to use the x-ray department as a sorting station before clinical methods, and the over-enthusiasm of junior residents to have everything radiogrammed before their chief orders it. This is incompletely solved by having a senior resident or member of the honorary staff sign requisitions.

Therapeutic equipment should include deep therapy, superficial therapy, and possibly Chaoul apparatus. It is absolutely necessary that beds be allotted to the department in view of modern protracted therapy.

The author would have either an honorary radiotherapeutist and an honorary radiodiagnostician or a director with an assistant honorary radiotherapist and assistant honorary diagnostician. These should have full-time paid assistants at the rate of about one per 10,000 cases annually.

The lay staff should be in charge of a nurse. Radiographers should number about one per every 5,000 to 6,000 cases a year. This might be reduced if a training center were established in the department but then the problem of teachers arises. The Society of Radiographers should issue some type of teaching certificate which the senior staff radiographer should have. The darkroom staff should be composed of trained photographers rather than radiographers and should number one for every 10,000 to 12,000 films a year.

Teaching senior students requires that senior radiologists have sufficient assistants to provide the necessary time. This department and staff would also provide every facility for research. One shorthand-typist per 10,000 reports is the minimum, which must be exceeded for really adequate records and follow-ups.

The above set-up is not over-elaborate since the x-ray department is probably the largest auxiliary service supplied by the hospital. In his hospital of 69,762 patients, 30,000 were referred to the x-ray department, and of 12,657 in-patients, 9,000 were referred.

Dr. J. Struthers Fulton: Radiotherapy is assuming a rôle of increasing importance in modern medicine. Radium therapy has, unfortunately, become somewhat divorced from x-ray therapy. If radiology must divide, this should occur between diagnosis and treatment. In a 600-bed hospital, about 20 beds are in constant use for radiotherapy. These should be in a unit, under the control of the radiotherapist.

The author gives a plan based on a floor space of 30×200 feet. The primary consideration which determines the layout is the provision of adequate protection to the staff. Full use is made of distance and powerful sources of radiation (radium beam, 400 kv. plant and 200 kv. plants) are placed as far toward the ends of the department as possible. Facility in routine follow-up of cases should be obtained by the arrangement.

The author suggests, as apparatus, a five-gram radium beam unit, a 400 kv. plant and two 200 kv. plants, each of the latter operating two tubes in parallel and wired so that each machine could operate all four tubes. Provision for a radium safe (capacity 1 gm. in needles and tubes), a radium preparation room, mould

room, and dosage-calculating room are included. Waiting rooms in most hospitals are inadequate and this condition should be corrected.

Dr. R. J. Sankey: The value of radiologic service is in proportion to its liaison with clinical services. The department should, therefore, be as near the center of clinical work as possible, for easy co-operation. The least a clinical staff can do is to furnish a tentative diagnosis or clinical notes, when discussion is not possible. Spot diagnosis from radiographs should be a thing of the past. With growing experience the radiologist is less prone to be dogmatic and more anxious to discuss cases before drawing conclusions.

[1] One radiographic room is needed for every 100 beds but figures from hospitals are given showing 157 beds per room. The out-patient volume also must be considered. Division of work is discussed, each room being fitted for some special type. A special investigation room is valuable.

RAY A. CARTER, M.D.

RADIUM

Biological Effects of Alpha Rays, with Special Consideration of the Problems of Radium Therapy Using Extremely Low Doses. K. Inouye. Strahlentherapie, **64**, 175, 1939.

The author studied the effect of very small doses of radium on fibroblasts and sarcoma in tissue cultures. The medium contained 2.55×10^{-6} grams radium element per c.c. The metabolism of the cultures was determined according to the method described by Warburg. A definite relationship could be established between the dose and the metabolism. The effect of the radiation in the author's experiments was dependent upon the temperature.

Additional experiments were undertaken in humans, who were given baths containing radium emanation varying from 17,000 Me. to 60,000 Me. (Mache-units). The leukocyte and differential count were used as indicators. Four to five hours following a single bath a definite leukocytosis developed, followed 20 hours later by a leukopenia. Slight changes in the differential count were observed sometimes after one, with certainty after several baths. A definite correlation existed between the emanation found in the air expired from the lungs, or, in other words, between the emanation concentration in the blood and the variation in the leukocyte count.

ERNST A. POHLE, M.D., Ph.D.

Radium Therapy of Bladder Carcinoma: Five-year Results, Failures, and Future Therapy. Benjamin S. Barringer. Jour. Urol., **40**, 606–611, November, 1938.

At the Memorial Hospital, New York City, 215 cases of bladder carcinoma treated cystoscopically and by suprapubic implantation, show three-year cures in 69 cases (32 per cent), five-year cures in 52 cases (24.1 per cent), and cancer-free cases in 96 instances (44.6 per cent). Tissue removed from the cured cases are classified as follows:

	Cases
Papilloma with atypical cells	5
Papillary carcinoma	14
Infiltrating carcinoma	16
Adenocarcinoma	1
Grade I	10
Grade II	30
Grade III	12
Grade IV	2
No pathological examination	6
Total	96

The time periods of cured cases varied from less than one year to more than 20 years.

The author states that the fatal cases die within the first year. The chief cause of death is unquestionably severe infection of the bladder and kidneys. Probably few actually die of carcinoma.

The factors influencing the type of therapy are size of tumor, grade of tumor, position of tumor, and condition of the kidneys. The best surgical five-year results in bladder cancer are 25 per cent. These cases include only those which can be removed surgically. The statistics in the present series of cases include all cases of carcinoma of the bladder seen, regardless of the extent of the lesion. At present, the author is favoring cystoscopic treatment in preference to a suprapubic approach. The various forms of radiation in use are classified as follows: radon seeds, x-ray alone, x-ray plus radon seeds, fulguration, fulguration and x-ray, pre- and post-operative x-ray irradiation, and radium application.

The author states that an infiltrating carcinoma is more difficult to cure than a papillary carcinoma. Bladder carcinomas are more frequently single than multiple.

JOHN G. MENVILLE, M.D.

Intra-uterine Radium Therapy of Hemorrhagic Metropathies. A. Pickhan. Strahlentherapie, **63**, 682, 1938.

The biologic effect of radium in cases of uterine bleeding may be due to changes produced in the mucosa, the muscles, and the ovaries. By calculation, the author estimates the dose reaching the ovaries during intra-uterine radium application of 1,500 mg.-hr. at approximately 360 r. This cannot be compared with the equivalent dose in x-rays because of the different method of administration. While x-ray therapy takes usually less than one hour, the radium dose is applied over a period of from 20 to 40 hours. The author uses a filter of 0.5 mm. Al only, in order to utilize the beta and soft gamma rays. In his opinion the effect on the bleeding uterus is due to an influence of the rays on the blood vessels in the mucosa as well as on the follicles. Because of careful selection and preparation of the patient, also limitation of the treatment to preclimacteric bleeding, the author has seen no failure of radium therapy.

ERNST A. POHLE, M.D., Ph.D.

Danger of Introducing Radio-active Substances into the Body of Mammals: Experience with Two Mares. T. Nogier. Bull. et mém. Soc. de radiol. méd. de France, **26,** 362–365, May, 1938.

In June, 1934, a milligram of radium sulphate was given intravenously to two mares weighing 600 kg. The animals remained in good health until 1937, except for a marked leukopenia. In 1937, one animal died and an autopsy revealed a fracture of the pelvis. The bones revealed twice the radio-activity of the blood serum, determined three years previously.

The other mare lived until January, 1938, when a spontaneous fracture of the tibia allowed the mare to fall and choke to death in her halter. The radium content of the bones was four times that of the blood, examined three and one-half years previously.

The dose given was equivalent to 0.1 mg. given to an individual of 60 kg. The author stresses the danger of giving radio-active substances internally, emphasizing the relative potencies of the α and β radiations in intimate contact with the cells.

S. R. Beatty, M.D.

The Development of Gynecological Radium Therapy, Especially in the Treatment of Non-malignant Disease. C. J. Gauss. Strahlentherapie, **63,** 561, 1938.

The author, one of the first pioneers in gynecological radiation therapy in Germany, presents a brief sketch of the progress made in the therapeutic use of x-rays and radium in this specialty. His first paper, dealing with the treatment of uterine fibroid by roentgen rays, was presented in 1912. Since then he has been identified with many new developments in this field. Because of the possible danger to future offspring, he advises against temporary sterilization. He emphasizes the usefulness of a combination of x-rays and radium in many conditions.

Ernst A. Pohle, M.D., Ph.D.

THE RECTUM

Melanosis Coli. Louis A. Buie. Minnesota Med., **21,** 561–563, August, 1938.

The condition was first described by Cruveilhier a century ago. After its discovery, all studies of the condition were based upon postmortem reports, until the work of Bockus, Willard, and Bauk, which was published in 1933. They found an incidence of 2.7 per cent in the examination of 960 routine "office" patients. Of their patients, 88 per cent were females.

Melanosis coli consists in melanotic deposits in the rectal mucosa. There is rather wide variation in the color of the lesions, but the appearance and arrangement are usually unmistakable, and if the mucosal surface is rubbed with a cotton applicator, inflammatory or ulcerous change, with which the condition may be confused, will not be found. If inflammatory reaction is present, the pinkish stain of serosanguinous exudate will appear on the cotton applicator, when the diseased mucous membrane is traumatized. If there is no such stain, the condition may be melanotic. The pigment may be light brown, dark brown, or black. It may be scattered in the mucous membrane, or it may leave no part of the lining of the bowel uninvolved; it is rare for the condition to extend beyond the confines of the colon. On closer scrutiny, it will be observed that the coloring is not solid but is divided by linear, yellowish markings, into small segments, usually several millimeters in diameter.

In the author's experience, it occurs almost entirely in constipated individuals. Bartle first called attention to the possible relationship between the constant ingestion of cascara and melanosis coli. The condition may arise as a result of phagocytosis by the mucosal cells.

There is no evidence that the physician should be concerned over the presence of melanotic pigment in the walls of the colon. It has not appeared to have any direct relationship with the development of carcinoma, except as a possible result of the obstructive effect of the carcinoma.

Percy J. Delano, M.D.

Rectal Symptoms from the General Surgeon's Standpoint. Harvey B. Stone. Jour. Am. Med. Assn., **109,** 1679–1681, Nov. 20, 1937.

The signs and symptoms that accompany rectal disorders may be grouped under comparatively few headings: sensory disturbances, abnormal secretions or discharges, disturbances of defecation, anatomic changes. The duration of any of these derangements and their intensity are also of important bearing in many cases.

Many rectal disorders have a quite characteristic symptom-complex. The difficulty in eliciting a description of it lies in the widespread habit of patients being vague in their complaints and description of rectal disturbances. To obtain a comprehensive history questions pointed on the above headings must be asked. The making of a proper local examination is a necessary requisite to proper diagnosis.

The characteristics of the symptoms are discussed in detail.

Charles G. Sutherland, M.D.

SARCOMA

Results of Radiation Therapy in Sarcomas. O. Walther. Strahlentherapie, **64,** 59, 1939.

This paper, of 53 pages, represents a thorough statistical survey of the 240 sarcoma cases seen at the Roentgen Institute of the University of Zurich from 1919 to 1936. The results are compiled in numerous small, and ten major, tables. There were 132 men and 108 women; the average age was 44.8 years. Solitary giant-cell tumors, lympho-epithelial neoplasms, and melanomas were not included in this survey. The localizations were as follows: Gastrointestinal tract, 19 per cent; supporting tissue, 16 per cent; skeleton, 14 per cent; respiratory system, 13 per cent; thyroid, 12 per cent; lymph nodes, 9 per

cent; genito-urinary tract, 7 per cent, and breast, 2 per cent. The diagnosis was verified by biopsy in 91 per cent. Among these were round-cell, lymphoid, spindle-cell, and polymorpho-cell sarcoma, some unclassified, also fibrosarcoma, hemangio-endothelioma, Ewing's tumor, endothelial sarcoma, osteogenic sarcoma, myxofibrosarcoma, plasmocytoma, and myeloma.

Thirty-eight, or 16 per cent, were treated by a combination of surgery and radiation and the remaining 202, or 84 per cent, were irradiated. In 28 per cent, radiation therapy was used for palliation only. Of 237 cases observed for one year, 29 per cent were free from symptoms. Of 223 cases observed for three years, 20 per cent are free from symptoms, and of 201 cases observed for at least five years, 13 per cent were well at the time of the study. Thirteen per cent were operable at the time of admission and 87 per cent inoperable. The percentages of cures for the 31 operable cases were 63, 56, and 35 per cent for observation periods of one, three, and five years, respectively. The respective figures for the 209 inoperable cases are 23, 14, and 10 per cent. The best results were obtained in tumors of the orbital and ear region, in the oral cavity, the mesopharynx, the mediastinum, and the supporting tissue. In those, the five-year cures amounted to over 25 per cent. Of the 75 per cent who died from the disease, 62 per cent received palliation. The average period of survival was 12.2 months in this group. Good palliative results were seen in tumors of the paranasal sinuses, the epi- and nasopharynx, and the mediastinum, while poor results were obtained in tumors of the kidney, the colon, and the bladder.

ERNST A. POHLE, M.D., Ph.D.

Voluminous Osteogenic Sarcoma of the Left Coxo-femoral Region. Carteret, Dillenseger, and P. Bertrand. Jour. radiol. et d'électrol., **22,** 558, 559, November, 1938.

The patient, a man 45 years of age, complained of pain in the left knee joint and difficulty in walking. However, x-ray examination showed a normal left knee joint. Physical examination showed a tense, fluctuant mass in the region of the left hip and sacro-iliac joints, suggesting an infectious process. The temperature was 38.5° C. (normal 36.8°).

X-ray examination of the left hip joint showed complete disappearance of the head and neck of the femur, with upward and lateral and posterior dislocation of the metaphysis of the femur. The left iliac bone showed very extensive destruction, with marked medial displacement of the acetabulum into the pelvic cavity. Much bone débris was seen in the soft tissues about the hip joint. Some bone production was also noted although it was atypical. A diagnosis of osteogenic sarcoma was made.

Because of the extent of the lesion no active treatment was instituted.

J. SAGEL, M.D.

SCHÜLLER-CHRISTIAN'S DISEASE

Schüller-Christian's Disease. M. Esser. Schweiz. med. Wchnschr., **68,** 1014–1017, Aug. 27, 1938.

This is the report of a case of Schüller-Christian's disease diagnosed in a child, observed for three years, and practically well at the time of the report. The patient was a female, 14 months of age, who had shown fever, sniffles, and headache for about six months. Enlargement of the spleen and liver, cranial deformity, and typical roentgenologic signs were present. Biopsy (lymph gland puncture and also sternal puncture) showed reticulo-endothelial elements containing many diplococci.

The author concludes, on the basis of this evidence, that the disease is infectious.

LEWIS G. JACOBS, M.D.

Schüller-Christian's Disease. M. Schieber. Polski Przegl. Radiol., **13,** 57–77, 1938.

The author presents three cases of Schüller-Christian's disease. He points out that the classical triad of symptoms ("geographical" skull, exophthalmos, and diabetes insipidus) is occasionally missing and the disease may be characterized by only one of these three manifestations. Not infrequently, symptoms of disturbed cholesterin metabolism are observed in other parts of the skeleton and in other organs. The examination of the blood reveals a marked increase of the cholesterin values.

The prognosis of the disease is favorable. Small doses of roentgen therapy may not only improve the condition but even produce a permanent cure, with complete disappearance of the lacuna-like changes in the cranium.

ERNST A. SCHMIDT, M.D.

SILICOSIS

Factors which Determine the Diagnosis of Silicosis. Charles L. Sutherland. British Jour. Radiol., **11,** 414–421, June, 1938.

The diagnosis of silicosis depends on three factors: radiologic examination, industrial history, and clinical findings. The radiologic examination is the most important; fluoroscopic examination is valuable, but a good technical film is essential.

The film will show numerous dense, discrete, circular opacities uniformly distributed throughout the lungs. Chronic miliary tuberculosis and carcinomatosis may show the same appearance. The opacities in silicosis are from one-eighth to one-fourth inch in diameter. They may be so dense as to suggest calcification. Owing to the projection on a flat surface, the density may appear greater than it is. Classification of degree of involvement should not be made from the film alone, as it will not give indication of the degree of impairment of pulmonary efficiency. Larger opacities may be formed by the fusion of individual densities. Emphysema is frequent.

The supervention of tuberculosis may modify the appearance. Tuberculosis seems to accelerate the fibrosis.

The diagnosis of tuberculosis may depend upon clinical and laboratory findings. Carcinomatosis may present a difficult problem in differential diagnosis and here the clinical course is important.

The classical type just described is not the most common seen, as many variations occur. The other two factors, industrial history and clinical findings, must be taken into account. Hasty conclusions are to be avoided. The variations in appearance must be differentiated from: simple exaggeration of the normal markings; excessive deposit of dust without fibrosis; nodular fibrosis due to other dusts; congestion, and tuberculosis.

Variations are found particularly in coal miners, where bilateral massive densities are seen. These are thought to be due to the accumulation of dust behind blocked lymphatics.

Asbestosis usually presents greater infiltration at the bases.

SYDNEY J. HAWLEY, M.D.

SKIN DISEASES

Roentgen Therapy in Dermatology. Carlo Guarini. Arch. di Radiol., **14,** 69–102, January-February, 1938.

In a lengthy paper the author discusses his own experience and adds that of authority in the literature in the roentgen therapy of dermatologic affections. The paper is well worth reviewing in the original. One gets the impression that the author "hits a little harder" than most American dermatologists and tends to follow, as is natural, European technics.

E. T. LEDDY, M.D.

Results of Irradiation with Soft Roentgen Rays at a Very Small Focus-skin Distance (Contact Therapy). D. den Hoed. Acta Radiol., **19,** 239–249, September, 1938.

Experiments undertaken by the author proved that the relatively soft rays employed in the so-called contact therapy have a similar biological effect to that of harder rays. The depth distribution of radiation was found to be almost identical with that of radium contact therapy.

The results in superficial malignancies of the skin were highly satisfactory. Metastatic skin lesions were also influenced favorably.

The author stresses the limited applicability of this type of therapy which, due to its lack of penetration, is primarily destined to remain a treatment for superficial affections.

ERNST A. SCHMIDT, M.D.

X-ray Treatment of Erysipeloid. Maurice A. Walker and Lewis G. Allen. Jour. Kansas Med. Soc., **39,** 383, September, 1938.

Erysipeloid is described as an entity in dermatological text-books. Following a break in the skin while handling fish, typical local inflammatory changes occur without constitutional symptoms. The authors report a case which was treated by roentgen therapy with good results. The dose consisted of 150 r generated at 90 kv. and filtered through 1 mm. of aluminum. This was repeated every third day for a total of four doses. The patient improved rapidly and was able to return to work four days after the last roentgen treatment.

L. W. PAUL, M.D.

THE SPINE

Compression of a Vertebra by a Hemangioma which was Clinically Cured by Radiotherapy. G. de Luca. Arch. di Radiol., **14,** 271–278, 1938.

A case of probable hemangioma of the eleventh dorsal vertebra received a course of protracted fractional x-ray treatments through two dorsal oblique fields with a total dose of 2,000 r per field (200 r a day) with resultant marked improvement. Repetition of treatment gave an apparent cure. The author feels that his case is a valid one even though the roentgenograms were not "characteristic."

E. T. LEDDY, M.D.

A Case of Vertebral Disease, Difficult to Diagnose, in Retrospect. C. Roederer and Choffat. Bull. et mém. Soc. Radiol. Méd. de France, **26,** 13, 14, January, 1938.

A boy 14 years of age had, from the age of three, shown a round back, apparently of the juvenile type. Roentgenograms demonstrated changes in the lower dorsal spine which, the authors believe, may be due to a "dry" type of Pott's disease.

S. R. BEATTY, M.D.

The Roentgen Diagnosis of Tuberculous Spondylitis. Nils Westermark and Gösta Forssman. Acta Radiol., **19,** 207–214, September, 1938.

Tuberculous spondylitis can be divided, roentgenologically, into a focal osteitis and a diffuse osteitis. While the focal osteitis type is more frequent in adults, diffuse osteitis is more prevalent in childhood.

Focal spondylitis may be sub-divided into two different types. One type presents definite osteosclerosis and periosteal deposits during its initial stages while the other type is characterized by rounded or irregular sequestration and a rarefied border zone. Both types of focal spondylitis are most frequently seen in the anterior lateral border of the vertebral body. The radiographic detection of focal spondylitis is possible at a relatively early stage of the disease. On the other hand, diffuse tuberculous spondylitis is, as a rule, discovered at a comparatively late stage.

ERNST A. SCHMIDT, M.D.

Radiation Therapy of Primary Hemangioma of the Vertebræ. Ira H. Lockwood and Charles E. Bell. South. Med. Jour., **31,** 827–834, August, 1938.

In 1927, Schmorl's Institute reported that heman-

giomas were found in 10 per cent of all spines examined there. Most often they existed in the thoracic and lumbar areas. When symptoms are present, the clinical picture is of low back or leg pain with remissions and relapses or spastic paraplegia. The radiographic appearance is characteristic, with dense vertical trabeculæ in the body of the vertebra, separated by areas of irregular bony trabeculæ, giving the bone a striated appearance.

Radiation is the treatment of choice, producing symptomatic relief, but no change in the architectural appearance of the vertebræ. In three cases reported, the authors, using 200 kv. and heavy filtration, applied dàily, or at short intervals, 200 r units for a total of from 1,800 to 2,550 roentgens, in two instances giving additional irradiation one month later. Excellent results were obtained.

JOHN M. MILES, M.D.

A Case of Echinococcus of the Spine Difficult to Interpret Roentgenologically. Carlo Guidotti. Arch. di Radiol., **14,** 304–308, 1938.

In this case no definite diagnostic data could be obtained except those specifically for echinococcus, which were positive. Operation proved the diagnosis and cured the patient.

E. T. LEDDY, M.D.

Changes in the Vertebral Column Following Tetanus. E. Feistmann-Lutterbeck. Acta Radiol., **19,** 391–398, October, 1938.

The author subjected the spines of 14 patients, who had suffered from tetanus, to roentgenological examination. In only one case, that of an eight-year-old boy, pathologic changes attributable to tetanus were determined. These findings, which were seen two and one-half years after tetanus, consisted in flattening of the body of the seventh thoracic vertebra; the adjoining disks showed little change. Pathologic changes in a second case were probably due to a preceding spondylitis. In the remaining 12 patients, the findings were either normal or inconclusive.

ERNST A. SCHMIDT, M.D.

SYPHILIS

Gastric Syphilis, Pseudo-neoplastic Type: Clinical and Radiologic Study. H. Marc and Sire. Arch. d. mal. de l'app. digestif, **28,** 813–819, October, 1938.

After a year of gastric distress characterized by constant pain, digestive disorder, and weight loss, the patient, a woman 47 years of age, was examined by the authors following an abundant hematemesis.

The examination showed massive infiltration of the walls of the stomach, more marked on the greater curvature, with several irregular defects. There was no peristalsis, the stomach was rigid, and to palpation the stomach, antrum, and bulb appeared fixed, as though by perivisceritis. A diagnosis of massive neoplastic infiltration was made.

After another two and one-half years of constant distress, the general state of the patient was so good as to be incompatible with gastric carcinoma and the patient was placed on anti-syphilitic therapy (Bordet Wassermann 2+). After one and one-half months of treatment, there was marked clinical improvement.

In retrospect, there were several reasons to make a diagnosis of carcinoma questionable. The intense, persistent pain, the abundant hemorrhage, the absence of metastasis or cachexia, and the multiplicity of lesions, rare in carcinoma but frequent in syphilis, should have been given more consideration in the diagnosis.

S. R. BEATTY, M.D.

Two Cases of Gastric Syphilis. P. A. Blinkenberg. Acta Radiol., **19,** 480–486, November, 1938.

The relative rarity of gastric syphilis is demonstrated by the fact that during the last 15 years only seven cases were reported from the Scandinavian countries. The author adds two cases from Denmark, thus bringing the total up to nine cases.

One of these cases was seen in a 28-year-old woman whose complaints were pain in the region of the cardia and occasional vomiting. The roentgen examination showed a large filling defect in the pyloric canal, but no six-hour gastric residue. Ulcer régime and antisyphilitic treatment failed to relieve the patient's symptoms, and a gastro-enterostomy was performed. In the pyloric canal a large infiltration resembling a tumor was found but the histologic examination showed simple inflammation. A later x-ray examination showed that the filling defect persisted, although the Wassermann reaction had become negative following specific therapy.

The other case was observed in a 44-year-old woman whose complaints consisted in nausea, vomiting, and considerable loss of weight. Physical examination revealed a tumor of the size of a child's head in the right iliac fossa which upon exploration proved to be an ovarian cyst. A questionable resistance was felt in the epigastrium. The x-ray examination showed complete pylorostenosis, and cancer in the pyloric canal was considered. The ensuing operation failed to reveal any tumor. There was marked swelling of the stomach wall in the region of the canalis egestorius. The serological findings were reported as: Wassermann positive; Kahn positive.

In both cases the discrepancy between roentgenological findings and subjective symptoms was evident.

ERNST A. SCHMIDT, M.D.

Syphilis of the Bones and Joints. Frederick A. Jostes and Maurice B. Roche. Jour. Missouri Med. Assn., **36,** 61–68, February, 1939.

The authors present a survey of 111 clinically active bone and joint lesions resulting from syphilitic infection. Pertinent information from the case histories is presented in tabular form. In the group with congenital syphilis, periostitis, osteitis, osteochondritis,

and osteomyelitis were the most frequent lesions, in the order named. Bone lesions in the congenital syphilitic person may appear in the first or second month of life or may remain latent until adult age is attained. The most common form of latent congenital bone syphilis, the changes of which may occur in the decade between 15 and 25 years, is the saber shin. This is an ossifying periostitis or osteitis. A similar change may be found in the inner third of the clavicle.

Beside these osseous residua, active lesions may be encountered also in the late congenital stage and sometimes are seen concurrently with the appearance of interstitial keratitis. Among these active lesions are periostitis involving most frequently the tibia, fibula, radius and ulna; a symmetric hydrarthrosis which is painless, without limitation of motion, and negative to roentgen-ray examination, and a type of arthritis leading to ankylosis. The osseous lesions of acquired syphilis are seen more frequently in the late stage of the disease. Syphilitic osteomyelitis often presents a clinical picture similar to the pyogenic form. This is especially true if secondary infection has occurred. There is in this lesion, as in the one which it simulates, an involvement of all bone layers from the periosteal sheath to the marrow substance as well as the adjacent soft tissue. Gummatous changes are common and sequestrum formation may occur. The latter is usually the only indication for surgical intervention. In the joints a mild arthritis is observed occasionally in the secondary stage but is of minor significance.

Hydrarthrosis, without inflammatory changes, may occur and recur during the course of the syphilitic infection. In general, syphilis of the joint occurs in the third stage and is regarded as a tertiary lesion. A common late arthritic involvement is the synovial type, in which there is fluctuation and increase in the periarticular tissue and a hyperplastic synovial membrane. Clinically, it presents the picture of chronic synovitis. This eventually may become a chronic hydrops. The gummatous osteo-arthritis involves the larger joints such as the knee, and is not always bilateral. The Charcot joint is a neuro-arthropathy which occurs during the stage of cord lesions or tabes dorsalis. It may develop rather abruptly without any definite appreciable cause.

The treatment of syphilis of the bones and joints is constitutional and antisyphilitic and rarely surgical. A number of roentgenographs illustrating the more common lesions are reproduced in this paper.

LESTER W. PAUL, M.D.

THALASSANEMIA

Thalassanemia. Edward S. Mills. Arch. Int. Med., **62,** 1004–1014, December, 1938.

The author reports a case of thalassanemia or Mediterranean disease in a child of Greek parentage with a family history of similar conditions. Roentgenographs of the skull showed indefinite thickening of the frontal and parietal bones without ray formation. The long bones showed thin cortices with a broadening of the shaft. There was marked hyperplasia of the bone marrow of a proliferative type, but not differentiated. The liver, spleen, and heart were enlarged and atypical pigmentation of the skin was noted. The hemogram was abnormal in that normoblastosis and reticulocytosis with severe anemia of the orthochromic type were present.

The historical aspect of this disease is reviewed and attention is called to the differences between this condition and von Jaksch's disease as pointed out by Cooley. The minimal requirements for a diagnosis of thalassanemia are shown to be pigmentation of the skin, increase in the marrow cavity, splenic enlargement, intractable anemia with some degree of reticulocytosis and erythroblastosis, and hemosiderosis of the liver and pancreas.

C. W. REAVIS, M.D.

TUBERCULOSIS, RENAL

Renal Tuberculosis. Charles D. Donahue. Northwest Med., **37,** 350–353, November, 1938.

Donahue has found renal tuberculosis to be relatively rare, even among hospitalized tuberculous patients.

Studying a series from seven hospitals and sanitoria comprising a period of from four to ten years, he finds the following exceedingly interesting facts: (1) The age incidence is one of early life, but rarely found in children. (2) The patient may appear extremely healthy. (3) Tuberculous kidney should be removed as early as possible: no other treatment is justifiable (Young). (4) Caulk summarizes the reports of numerous authors by stating that 20 per cent of the patients will be dead in five years and that from 60 to 70 per cent of them should be cured.

Wildboltz has found that, in cases in which no operation was performed, 57 per cent of the patients died in five years.

ANTONIO MAYORAL, M.D.

TUMORS (DIAGNOSIS)

Teratomas and Dermoid Cysts. Waclaw Kuzma. Polski Przegl. Radiol., **13,** 145–152, 1938.

Teratomas and dermoid cysts are frequently visualized radiographically, due to the presence of osseous material or teeth within the tumor mass. In three cases of tumors of the pelvis in women, the author was able to demonstrate teeth. In one of these cases, the diagnosis of dermoid cyst was confirmed by autopsy. In another case, a tooth was seen in the left hemithorax. This tooth formed part of mandibular tissue which was contained in a large teratoma with malignant degeneration.

ERNST A. SCHMIDT, M.D.

The Value of the X-ray in General Practice. Charles G. Sutherland. Minnesota Med., **21,** 839–847, December, 1938.

Sutherland reviews the history and development of the roentgen ray in its application to medicine.

The diagnosis of bone tumors is dealt with exhaustively. As a working classification he gives: (1) Benign osteogenic tumors; (2) periosteal fibrosarcoma; (3) non-inflammatory lesions simulating benign conditions of bone; (4) giant-cell tumor; (5) benign angioma; (6) myeloma; (7) malignant osteogenic tumors; (8) inflammatory conditions simulating malignant lesions of bone; (9) Ewing's tumor, (10) malignant angioma, and (11) metastatic involvement.

The outstanding feature of a benign tumor of bone is retention of cortical contour. The cortex may be expanded or deformed but there is no solution of its continuity. On the other hand, the almost pathognomonic characteristic of the malignant osteogenic tumor is the definite break in the continuity of the cortical outline. Benign tumors occur, for the most part, about the age of puberty, or at least, early in life. This fact points to a disturbance in development of the cartilaginous elements in the formation of bones and joints.

Exostoses occur in two forms: the cauliflower excrescence of cartilage and the multiple symmetrically distributed lesions of the same type which are familiar to most roentgenologists as hereditary deforming chondrodysplasia.

Benign hemangioma occurs near the metaphysis of long bones. It expands the cortex but does not extend deeply into the medullary or cancellous spaces. The roentgenographic image is that of a "soap-bubble" and is somewhat similar to a giant-cell tumor. Simple cyst, osteodystrophia fibrosa, and giant-cell tumor would seem to fall into the same category, as to basic origin.

In the spinal column complete destruction of one or more vertebral bodies is suggestive of myeloma.

Sarcoma is divisible into several groups: (1) Subperiosteal and medullary sarcoma; (2) periosteal sarcoma; (3) sclerosing sarcoma; (4) telangiectatic sarcoma; (5) chondrosarcoma, and the sarcomas involving the diaphysis.

Careful technic is often required to demonstrate a subperiosteal or medullary sarcoma. More than one projection may be required to demonstrate the break in periosteum.

Sclerosing sarcoma shows an intense eburnation of the involved portion of bone. Particularly in the upper end of the tibia the tumor may be difficult to distinguish from syphilitic osteitis.

Ewing's tumor tends to involve the mid-diaphyseal portion of the shaft of long bones; it rarely affects persons more than 21 years of age.

Metastases may be osteoclastic or osteoplastic: the former type is most typically seen in the tumors of the breast. In the spine, it may be confined to a single vertebra as a destructive process. At necropsy, vertebræ have been found so softened that one could force a finger into them, yet the detection of the lesions roentgenologically called for the closest scrutiny. Small lesions may occur in the ribs.

Osteoplastic metastases are almost always secondary to carcinoma of the prostate. The first condition to be differentiated here is Paget's disease. In Paget's disease, the evidence of trabecular bony outline is always maintained or exaggerated; in carcinomatous metastases it is always obliterated.

Roentgenologic study is one of the best ways of arriving at the diagnosis of bone tumors; biopsy is required when surgical intervention is contemplated.

PERCY J. DELANO, M.D.

True Fibroma of the Stomach. C. Bonorino Udaondo, E. Finochietto, and D. Mosto. Arch. d. mal. de l'app. digestif, **28,** 590–607, June, 1938.

The authors present a new case of fibroma of the stomach. Roentgenologically, this appeared as a deformity of the antrum which appeared tubular and shrunken, with an irregular defect on the greater curvature. The operative specimen showed a superficially ulcerated fibroma of the submucosa about 6 × 3.5 cm. Exhaustive histologic studies proved the tumor to be a true fibroma.

The symptomatology, diagnosis, and histopathology of fibroma of the stomach are discussed. The authors have reviewed the literature, with especial reference to the frequency of occurrence of benign tumors of the stomach.

S. R. BEATTY, M.D.

Bony Intracranial Tumors. Cobb Pilcher. South. Med. Jour., **31,** 613–619, June, 1938.

Three unusual types of intracranial bony tumors, which were removed successfully, are reported.

The first is a case of an osteoma of the frontal sinus in a 20-year-old white male in whom the tumor extended into the orbit and cranial chamber. First noted was a slight hard prominence of the left forehead, increasing in size and followed three years later by swelling, exophthalmos, and pain behind the eye on the affected side. A multinodular tumor, measuring 8 × 6 × 5 cm., was removed at operation.

The second was an osteoma of the inner table of the temporal bone in a white female 41 years of age. Clinical symptoms and x-ray evidence were present for ten years before operation revealed a large nodular bony mass which had protruded through the dura and forced the temporal lobe of the brain upward. The symptoms were intermittent, unilateral headache, tinnitus, nocturnal convulsions, and occasional "dreamy state" attacks.

Case 3 was the report of a bilateral intradural bony growth in a white female 39 years of age. The symptoms were neurotic or mildly psychotic in nature, with severe and frequent headaches, and periodic elevations of blood pressure to 250 mm. systolic. The relation of trauma to the condition was obscure. At operation, a flat plaque of bone, 4 cm. wide and 15 cm. long, was found adherent to the dura and extending from the superior sagittal sinus overlying the cortex of the brain

to which it was lightly adherent in the right frontal and parietal regions. Small peripheral plaques were present and a small amount of similar bone was felt through the dura on the opposite side.

JOHN M. MILES, M.D.

The X-ray Aspect of Perisellar Tumors. Teofil Blühbaum and Marceli Spritzer. Polski Przegl. Radiol., **13,** 7–46, 1938.

The intracranial tumors may be classified as intrasellar, metasellar, and perisellar. This classification is based not only on radiologic-topographic reasons, but also on clinical-methodological considerations.

The x-ray diagnosis of the intrasellar tumors presents, as a rule, no unusual difficulties and is frequently possible after a single roentgenographic examination.

For the diagnosis of the metasellar tumors, the application of auxiliary radiographic methods (encephalography, ventriculography, or arteriography) is necessary.

The radiological diagnosis of perisellar tumors depends on special refinements of the available technical methods.

The authors discuss the anatomical conditions and the diverse projections of the sella turcica. The limitations of the radiological diagnosis and the general value of the different tumor signs and clinical symptoms are outlined in detail.

The observations and conclusions of the authors are based on 273 clinically diagnosed cases of intracranial tumors, of which about 50 per cent were confirmed by radiological examination and about 10 per cent verified by operation or autopsy.

A number of illustrative sketches and roentgenograms accompanies the article.

ERNST A. SCHMIDT, M.D.

TUMORS (THERAPY)

The Radiosensitivity of Ewing's Tumor. Georges-Claude Leclerc. Jour. radiol. et d'électrol., **22,** 550, 551, November, 1938.

This is a report of 14 cases of Ewing's tumor, all except two of which were treated with x-ray. The other two were treated with radium and, therefore, are not included in this report.

The disappearance of Ewing's tumor under x-ray treatment is so rapid and so frequent that it can be used as a therapeutic test, although the response is not absolutely constant. One of the author's cases was not influenced by x-ray treatment, although this was an advanced case which had been curetted and drained as osteomyelitis. The first symptoms that are influenced are pain and fever, followed by improvement in the general condition. Then the local inflammatory signs and the tumor mass begin to dissappear—this followed by gradual disappearance of the tumor, as seen on the x-ray films, with re-ossification and the return to apparently normal bone.

As to the ultimate results of treatment, one case (mentioned above) was not benefited. Of the other 11, the result of one case is unknown. One patient had a local cure but died of paraplegia soon after the beginning of treatment. One case has had no recurrence for ten years. All of the others have had recurrences which appeared from six to eight months after x-ray treatment was instituted, except for one which recurred two years later. The recurrence usually had the same x-ray appearance as the primary lesion.

Most writers report that the recurrences are radiosensitive like metastases, but five of the author's eight patients who were retreated showed no benefit. Of 18 cases, only three have survived: one by surgery alone, one by irradiation alone, and one by the combined treatment. In this series, the best treatment would seem to be a combination of surgery plus irradiation.

J. SAGEL, M.D.

Giant-cell Tumor ("Osteoclastoma") of the Femur Treated with X-rays. S. Dechambre, E. Dechambre, and J. Nebout. Bull. et mém. Soc. de radiol. méd. de France, **26,** 379, 380, May, 1938.

A tumor of the upper half of the left femur of a nine-year-old girl, diagnosed radiographically as a giant-cell tumor, was treated with x-rays. There was considerable soft-tissue swelling, with pain and loss of function. In 26 days, 13 treatments were given anteriorly and 13 posteriorly to the upper half of the thigh; 250 r to a single field of 225 sq. cm. was given daily (200 kv., 3 ma., 40 cm. F.S.D., 1 mm. Cu + 2 mm. Al + 1 cm. wood). During this treatment a fracture occurred, accompanying a considerable decrease in calcification of the bone. Clinical improvement occurred after two months. Films two years later demonstrated considerable recalcification of the bone with some deformity due to the fracture. Pain and swelling had not recurred.

S. R. BEATTY, M.D.

The Treatment of Malignant Granulomas by Radiotherapy. René Gilbert. Jour. de radiol. et d'électrol., **22,** 577–585, December, 1938.

X-ray therapy is the treatment of choice for malignant granulomas, and it usually produces remissions of considerable duration. Many cases are submitted for a therapeutic test of x-radiation. Treatment cannot be systematized and must be adapted to the individual case. The author emphasizes the anatomical and clinical characteristics of the disease.

X-rays produce a direct destructive effect on the granulomatous tissue which is followed by fibrous tissue formation. Local recurrences are usually due to insufficient dosage and to radioresistant types. Histologic study is no sure indication of radiosensitivity but indicates whether the specimen is fibrous or cellular. However, at times even the cellular form appears resistant at the beginning of treatment. The author feels that acquired resistance is due to short-spaced and often repeated doses of x-rays and confirmed this by experimentation on the seminal epithelium of the

rat. He advocates heavy doses at first, as with malignant tumors, with no radiation in the absence of recurrence to avoid or lessen acquired radioresistance. There is no difference in the biologic action of x-rays and radium.

Teleroentgen therapy has proved ineffective and dangerous and has been abandoned by most men, including Teschendorf, its originator, so that to-day the segmental (localized) therapy is the treatment of choice. As to posology, there are three factors: (1) The method of fractionation of the dose in relation to the time; (2) the total dose received by the diseased tissues, if they are deep, and (3) the total volume of irradiated tissues in relation to the exposed surfaces. The incidental dose per treatment is generally 250 r, an effective dose to the skin (180 r measured in air for a field of 150 square cm.), at the rate of from 10 to 20 r per minute. The total minimal depth dose is 500 r for a very radiosensitive lesion, given at the beginning of treatment. This will be increased for the less radiosensitive lesions, taking into consideration the condition of the patient, the blood picture, and the tolerance of the irradiated tissue. This will be followed by a complementary series in from six to eight weeks in the case of a large tumor which does not regress sufficiently. The total period of treatment is usually five weeks, with from 10 to 15 days per field. Prophylactic radiation, in the absence of recurrence, should not be given; but periodic examination should be made to discover and treat recurrences early. Statistics of the last 15 years, compared to those which preceded deep x-ray therapy, bear witness to the progress.

As to the age factor, the most favorable cases are in the third and fourth decades, and after the age of 40 years the disease assumes a more malignant character. Life has been prolonged in the more favorable cases. The effect of a remission produced by x-ray therapy is actually a clinical cure, with the ability to work and lead a fairly normal existence. Uneventful pregnancy occurred in a small number of cases during periods of remission.

The author presents his results in table form and also the reported results from the literature.

J. SAGEL, M.D.

THE UTERUS

The Development of Treatment Methods for Uterine Carcinoma at the Women's Clinic of the University of Würzburg. T. C. Neeff. Strahlentherapie, **63,** 569, 1938.

The author, who is the physicist of the Radiation Institute attached to the Women's Clinic of the University of Würzburg, outlines the methods used there in the treatment of uterine cancer. Depth doses for various qualities of roentgen rays, tables showing maximum doses for radium screens, and tolerance doses for intestines, bladder, and vagina are given. The technic of the combined x-ray and radium treatment is outlined in detail, including single and total doses in r for both. With proper distribution, the vaginal mucosa may tolerate as high a total dose as 20,000 r. The value of radiation therapy in inoperable cases is emphasized.

ERNST A. POHLE, M.D., Ph.D.

Involution of the Uterine Cavity after Irradiation of Fibromas. Guilbert, Tortat, Frain, and Le Guern. Bull. et mém. Soc. de radiol. méd. de France, **26,** 395–401, June, 1938.

The authors have made a practice of doing an hysterography on each case of uterine fibroids presented for radiotherapy, as a complementary method of diagnosis, and recently have added a second such study, six months after radiotherapy. Measurements of the shadow of the uterine cavity have demonstrated a reduction in size in only those cases in which the treatment succeeded in reducing the size of the fibroma.

S. R. BEATTY, M.D.

Carcinoma of the Uterine Cervix. Harry H. Bowing and Robert E. Fricke. Am. Jour. Roentgenol. and Rad. Ther., **40,** 47–52, July, 1938.

This review is of patients treated from 1915 to 1929, inclusive. All types were treated, from the early to the far advanced. It is felt that the intensive broken-dose method of radium therapy, followed by roentgen treatment, after thorough study and planning of each individual case, offers the best results.

Although the great majority of the patients treated were in an advanced stage, of the entire number 26.8 per cent lived five or more years. Of those with lesions in Stage 1, 69.2 per cent were well at the end of five years, and 60.2 per cent of those with borderline lesions. The risk is very slight, as there was only 1 per cent hospital mortality rate and that only in the advanced cases.

S. M. ATKINS, M.D.

Results and Experiences in the Treatment of Carcinoma of the Cervix, with Special Consideration of Radium Therapy. P. Caffier. Strahlentherapie, **63,** 639, 1938.

In the Women's Clinic at the University of Berlin, an "elective" therapy of carcinoma of the cervix is practised and advocated. All operable cases in good general condition are operated on and the remaining patients are irradiated. The author's report is based on 1,314 patients seen and treated in the period from 1926 to 1932. The absolute percentage of cure was 28.9 per cent and the relative percentage of cure of 399 cases operated on, 45.9 per cent. The respective figure for irradiated cases amounted to 21.9 per cent in 905 cases. Comparing the irradiated Groups I and II with the cases operated on, it appeared that only 35.8 per cent were cured by irradiation, a figure which is definitely lower than the one for the cases operated on. This observation strengthens his advocation of operation in suitable cases. Very striking were the good results obtained by radiation therapy in advanced stages of the disease; even in this group the five-year percentage amounted to 13.2. The mortality of intra-uterine

radium application was 1.5 per cent; only three definite cases of ulcerative proctitis were observed in this series.

ERNST A. POHLE, M.D., Ph.D.

Treatment of Myoma Uteri. Thomas B. Lee. Jour. Med. Soc. New Jersey, **35,** 590–594, October, 1938.

An analysis of 500 cases of uterine fibromyoma, seen on the gynecological service of the Cooper Hospital, in Camden, has convinced the author that radiation therapy is of limited usefulness. A total of 385 cases were treated surgically. No estimates of the irradiated cases are given.

The contra-indications to radiation therapy are outlined and a preference for radium is indicated. In 54 cases thus treated, a diagnostic dilatation and curettage were first performed, followed by the insertion of 100 mg. in the uterine canal for 24 hours, and screened by from 1.5 to 2 mm. of platinum or its equivalent. About a year is required for complete regression. A rapid sedimentation rate, leukocytosis, and pain are regarded as positive contra-indications to the use of radium. X-ray therapy is reserved only for inoperable cases, or cases in which the tumor is too large for radium (size of a three-months pregnancy).

MAX MASS, M.D.

Pretended Responsibility of Roentgen Therapy for Sarcomatous Degeneration of Irradiated Fibroids. Gaston Daniel. Bull. et mém. Soc. de radiol. méd. de France, **26,** 345–350, May, 1938.

There is no real foundation for the belief held by some, that irradiation therapy of fibroid tumors of the uterus initiates sarcomatous degeneration of these tumors. Several studies of large series of cases have shown conclusively that there is really a lower incidence of sarcomas in uteri previously irradiated than in those never treated by irradiation.

The author believes sufficient evidence exists to allow him to recommend adequate irradiation with roentgen rays and radium as the method of choice in treatment of sarcoma of the uterus, with hysterectomy to follow in certain cases.

He calls attention to the "sign of paradoxical radiosensitivity" as a diagnostic point. A supposed fibroma, which is rapidly reduced in size following irradiation only to recur soon after cessation of treatment, is almost certainly a sarcoma.

S. R. BEATTY, M.D.

The Present Method of Radiation Therapy of Uterine Carcinoma in the First Gynecological Clinic of the University of Munich. F. G. Dietel. Strahlentherapie, **63,** 614, 1938.

The author prefers the single radium application in carcinoma of the cervix rather than treatment in several series at intervals of several weeks. More weight is placed on radium therapy, although the great value of roentgen irradiation as a supplementary treatment is admitted. The technic for both x-ray and radium is described in detail. By very carefully controlled irradiation the percentage of radiation injuries could be definitely reduced. While the number of ulcerations seen during the period from 1935 to 1937 amounted to 3.73 per cent, and fistula to 0.31 per cent, the figures for the following year were only 1.26 and 0 per cent, respectively. Using a combined radium and x-ray irradiation in 64 patients with carcinoma of the fundus, freedom from recurrence for a period of from one to four years was observed in 75 per cent of all treated cases. Because of the lack of five-year data, no definite conclusions are drawn as to the comparative value of operation and irradiation. The author emphasizes the importance of good general care, especially as to diet and medication (tonics).

ERNST A. POHLE, M.D., Ph.D.